Naval Facilities Engineering Command
200 Stovall Street
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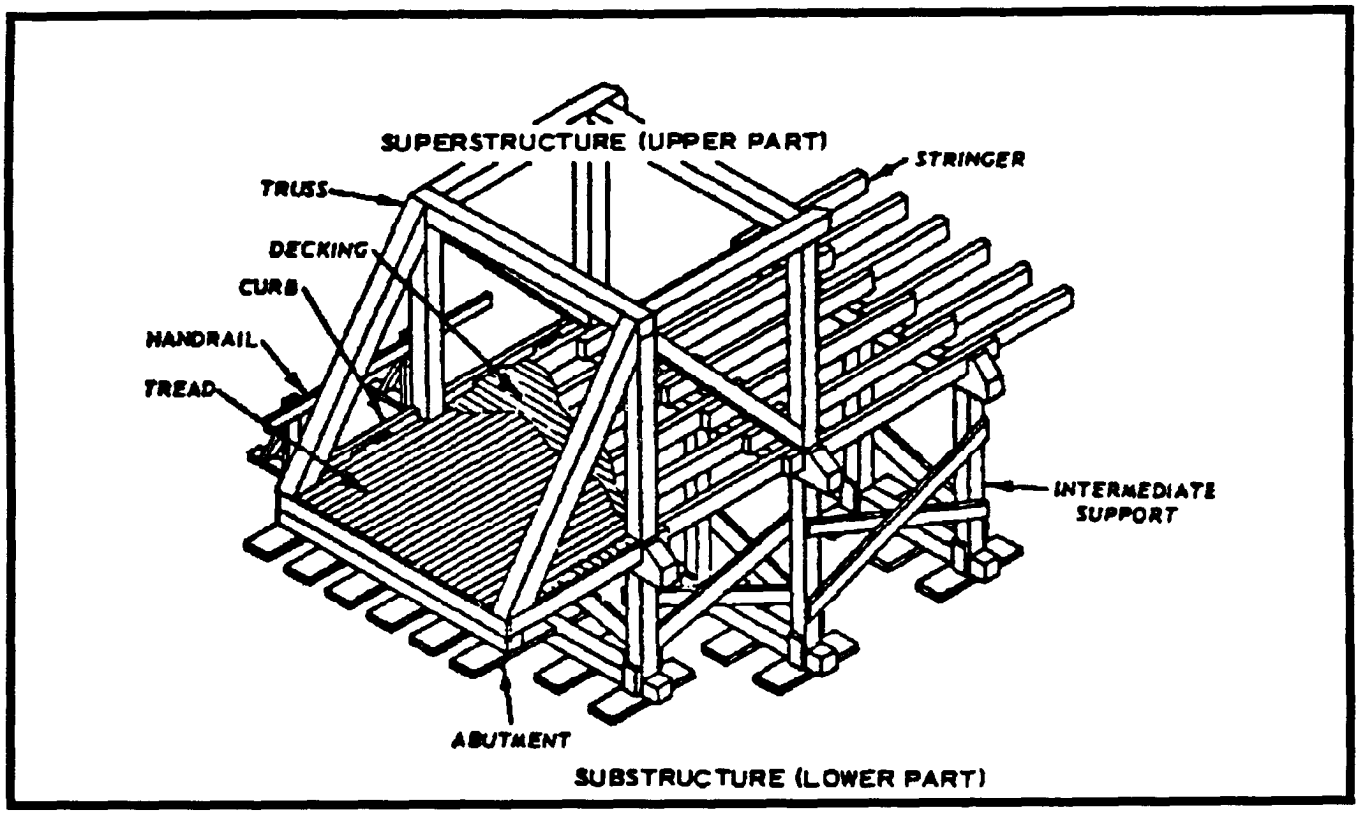
INSPECTION OF BRIDGES & TRESTLES



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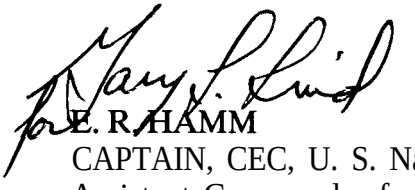
FOREWORD

The Navy has the responsibility to maintain approximately 600 bridges and trestles. The majority of the Navy bridges have not been structurally evaluated since their original design. Qualified condition inspection records are not available for many of the bridges. Some bridges have not been inspected by qualified personnel and inspection records never did exist. Enforcing bridge load restrictions and performing basic maintenance on the bridges will enable them to continue to survive with few failures.

This manual provides a guide for Navy bridge inspectors to use in implementing and administrating bridge inspection and maintenance programs. Included are annual and triennial bridge inspection guide specifications to assist in preparation of contract documents for those activities lacking in-house resources to do the inspections. Checklists are available for use by in-house/Engineering Field Division (EFD) engineers/inspectors.

Additional information or suggestions that will improve this manual are invited and should be submitted through appropriate channels to the Naval Facilities Engineering Command, (Attention: Code 1632), 200 Stovall Street, Alexandria, VA 22332-2300.

This publication has been reviewed in accordance with the Secretary of the Navy Instruction 5600.16A and is certified as an official publication of the Naval Facilities Engineering Command.



E. R. HAMM
CAPTAIN, CEC, U. S. Navy
Assistant Commander for
Public Works Centers and Departments

ABSTRACT

This publication provides information for Navy inspection personnel to use in implementing and administrating a bridge inspection program. Annual and triennial bridge inspection guide specifications and checklists are provided for inspection personnel. The primary focus is on identification of the basic bridge/trestle component parts, inspection methods, and reporting formats/checklists, to ensure that safety devices and structural components are sound and functioning as designed.

CHANGE CONTROL SHEET

Document all changes, page replacements, and pen and ink alterations posted in this manual.

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1.1 INTRODUCTION.

1.1.1 Purpose. Provide guidance for performing annual preventive maintenance inspections and control inspections of bridges. Annual and triennial bridge inspection guide specifications are provided in Appendices A and B. These specifications can be used to prepare contract documents for bridge inspections. The checklist in Appendix A should also be used for in-house annual inspections.

1.1.2 Requirement.

1.1.2.1 Annual inspections. Activities should perform preventive maintenance inspections of all bridges annually to ensure that safety devices, and structural components are sound and functioning. See Appendix A.

1.1.2.2 Control Inspections. MO-322 requires control inspection of Navy owned bridges. Additionally, 23 CFR 650, Subpart C requires biennial inspection and reporting of bridges on or over public roads.

1.1.2.3 Triennial Inspection. Activities should perform detailed engineering inspections of all bridges triennially to ensure that they are capable of supporting load requirements. These inspections shall be performed by or under the supervision of a registered professional engineer. See Appendix B.

1.2 BRIDGE ELEMENTS.

1.2.1 General. The two principle elements of a bridge are the substructure and the superstructure (Figure l-l).

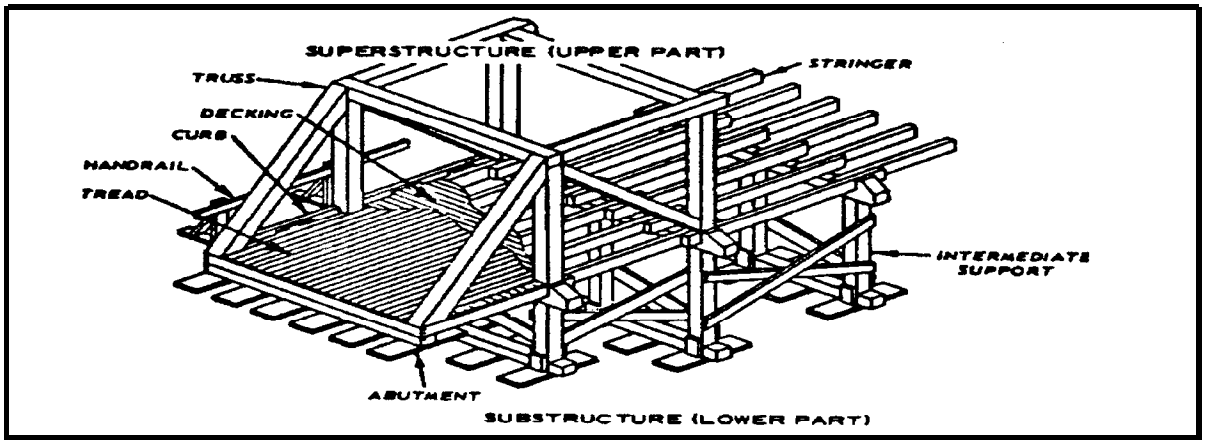

Figure 1-1
Bridge Elements

1.2.2 Substructure. The substructure includes those parts that transfer the loads from the bridge span to the supporting ground. For a single-span structure the substructure consists of two abutments. Multiple-span bridges have one or more piers or bents supporting the superstructure between the abutments. The substructure includes all those parts below the bearing plates.

1.2.2.1 Abutments. The abutment usually consists of a footing, a stern or breast wall, a bridge seat, a backwall, and wing walls. Abutments may bear directly on the soil, on footings or on piles. They may be made of timber, steel, concrete, stone masonry or a combination of materials. Figures 1-2 thru l-6 show typical abutments.

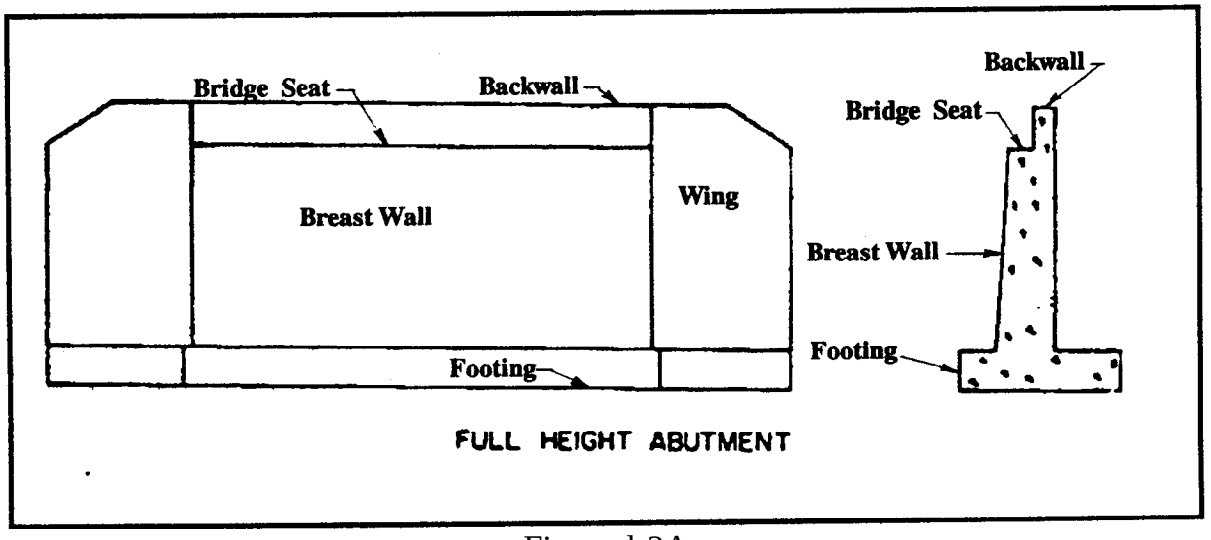

Figure l-2A
Full Height Abutment

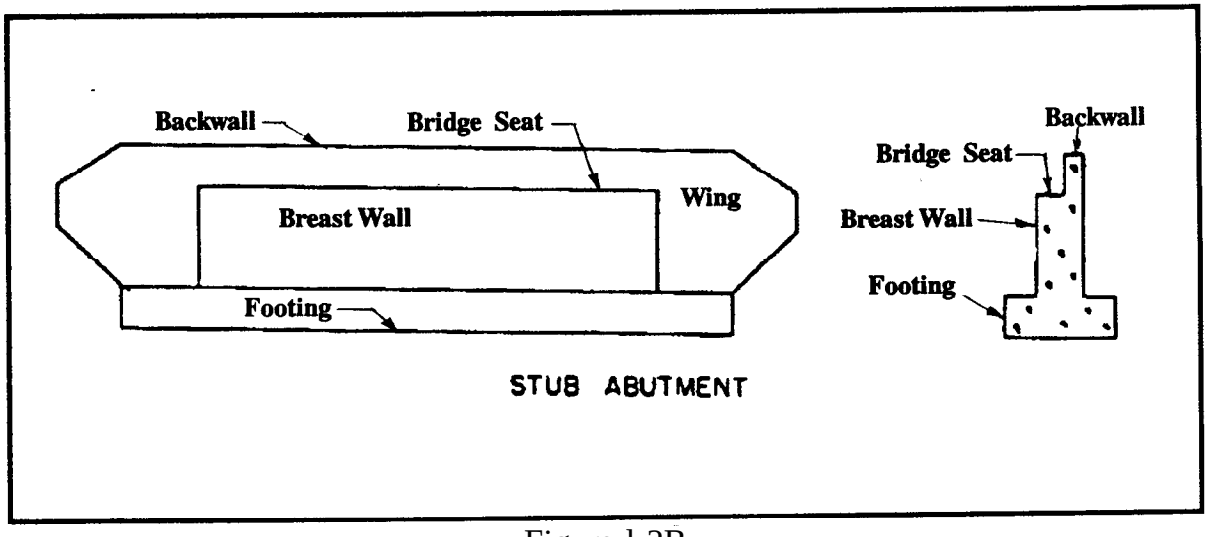

Figure l-2B
Stub Abutment

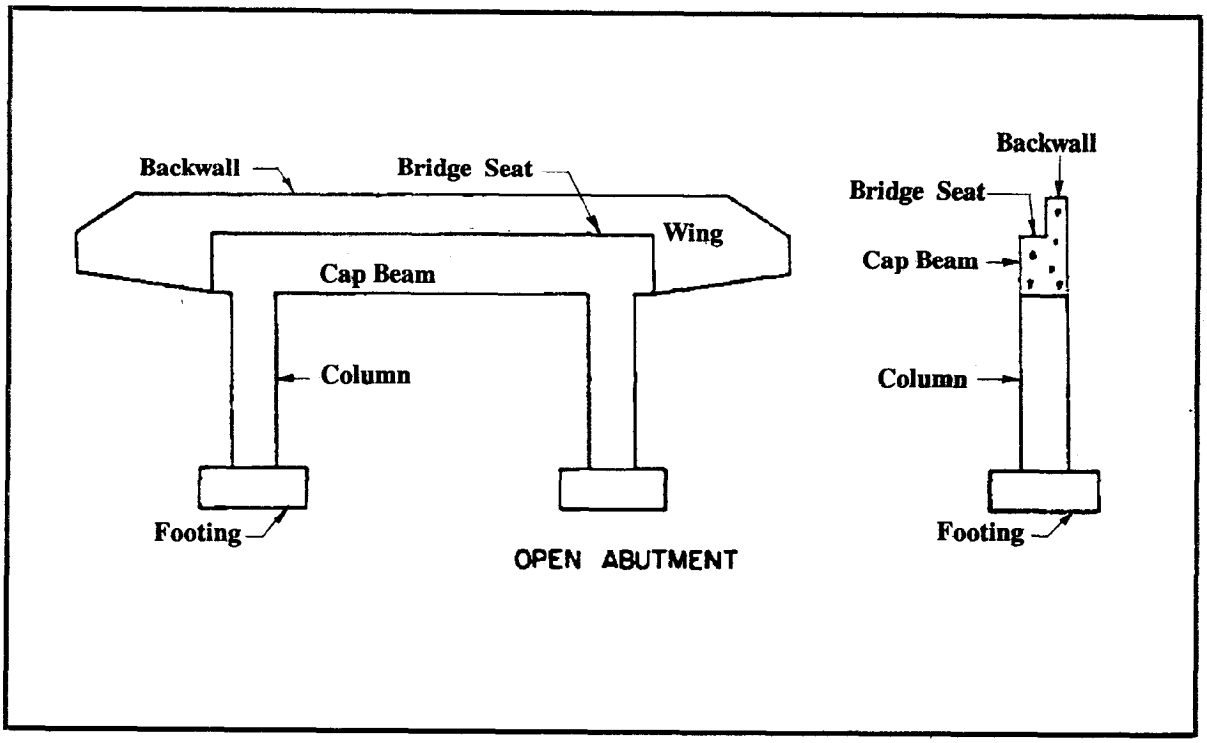

Figure l-2C
Open Abutment

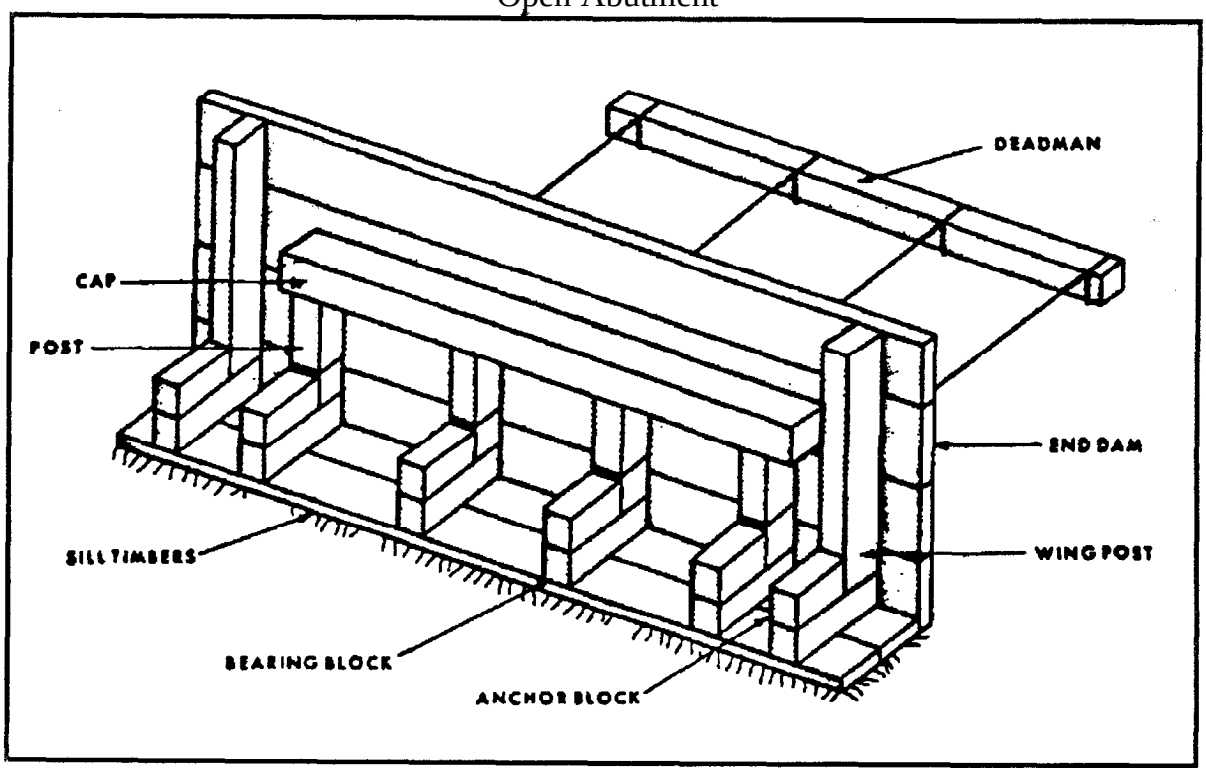

Figure 1-3
Timber Bent Abutment

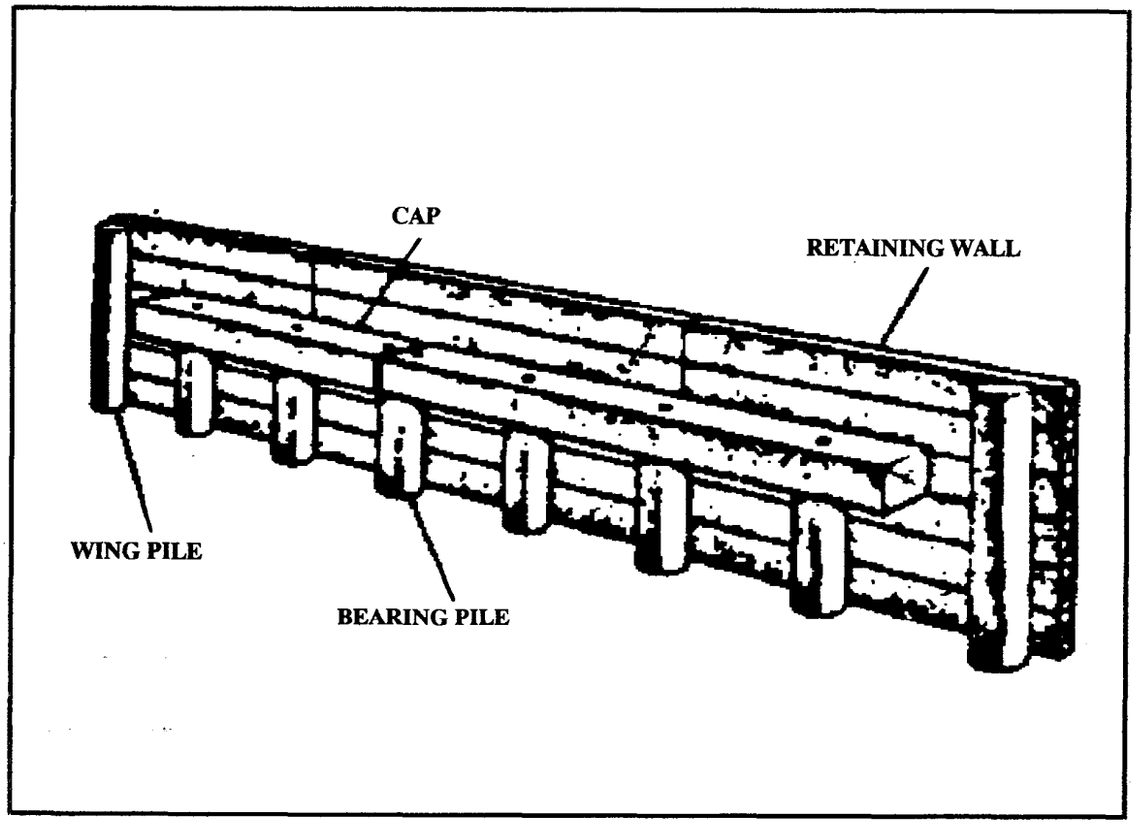

Figure l-4
Timber Pile Abutment

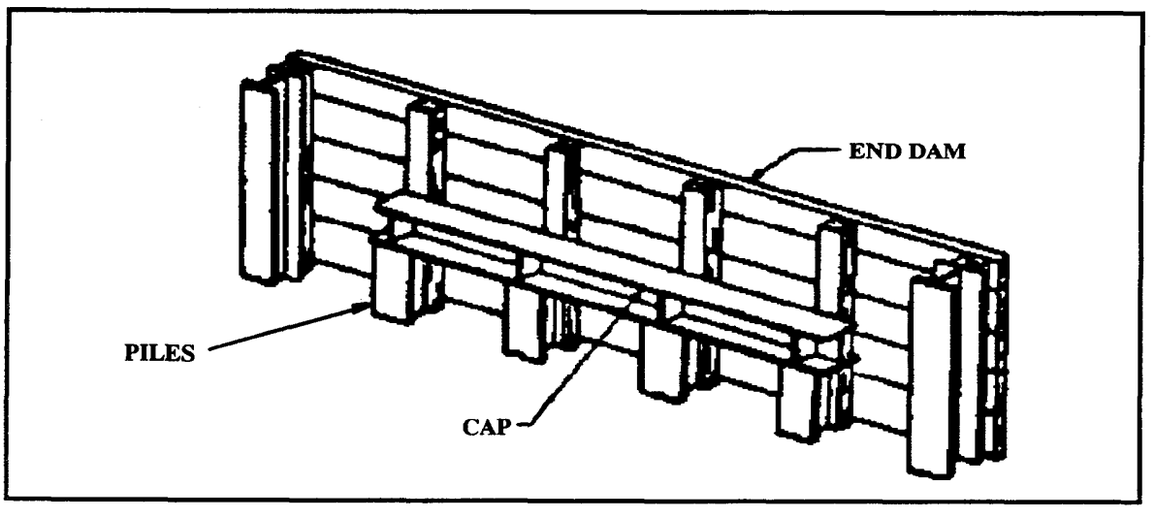

Figure l-5
Steel Pile Abutment

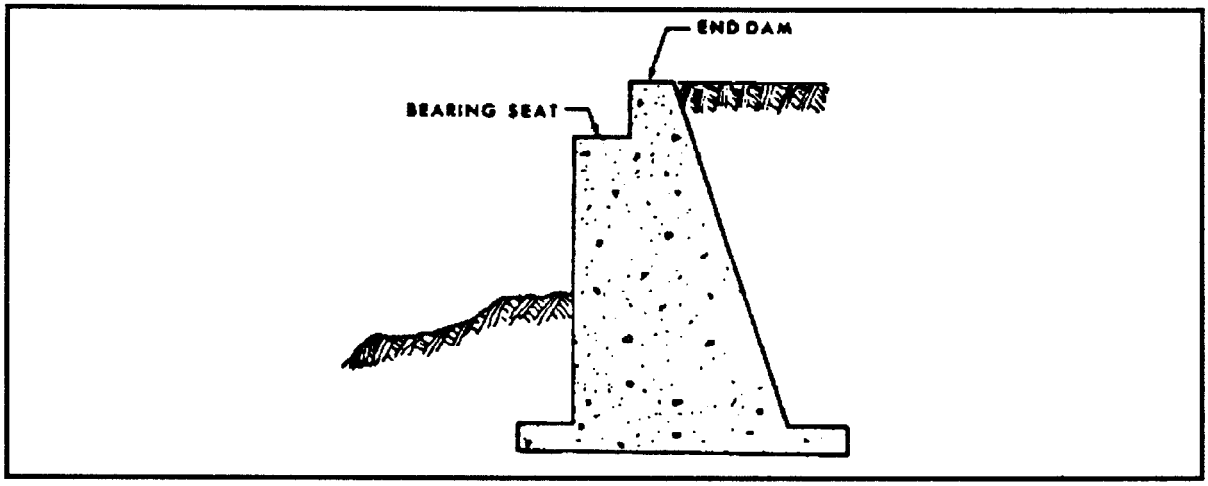

Figure l-6
Mass Concrete Abutment

1.2.2.2 Piers and Bents. A pier consists of a footing, a vertical element (columns, posts or stem), and cap. Footings transmit the load to the soil, rock, or to some other foundation unit such as piles, caissons, or drilled shafts. Vertical elements transmit the load to the footings. The cap receives and distributes the superstructure loads.. A bent consists of a single row of posts or piles in the transverse direction, while a pier may consist of two or more rows of posts or piles. A pier may also be a wide concrete support. Figures 1-7 through 1-10 show typical piers.

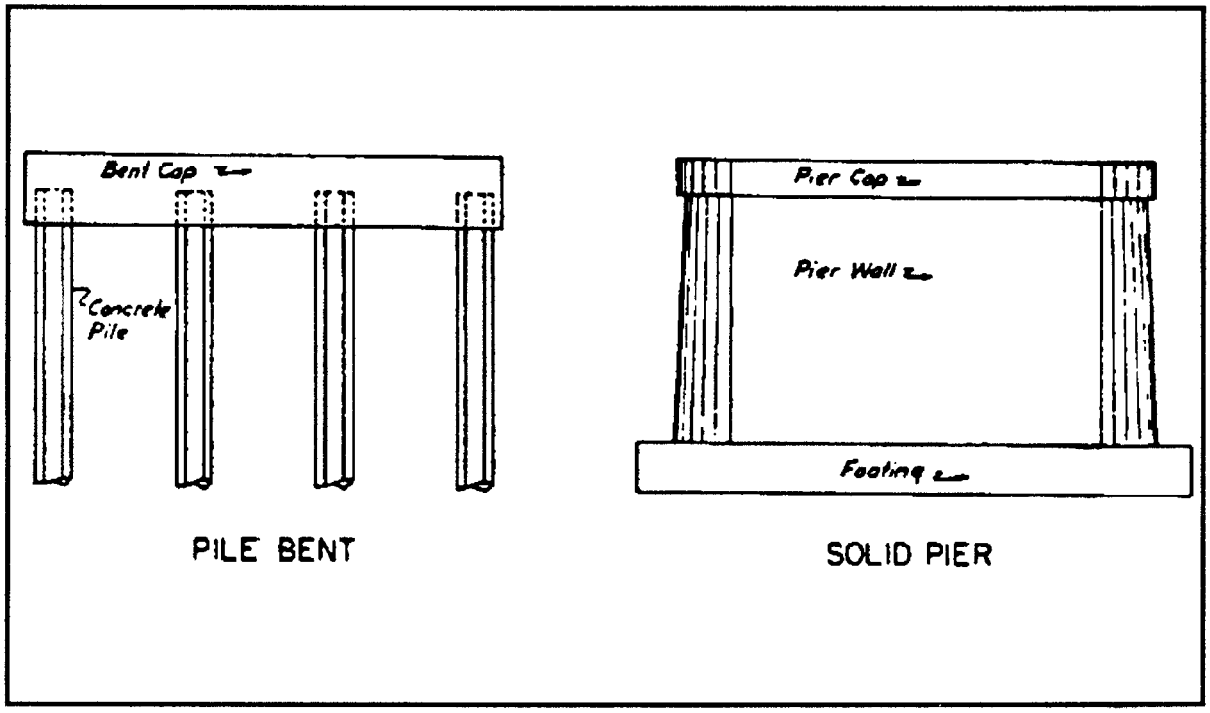

Figure 1-7A
Types of Bents

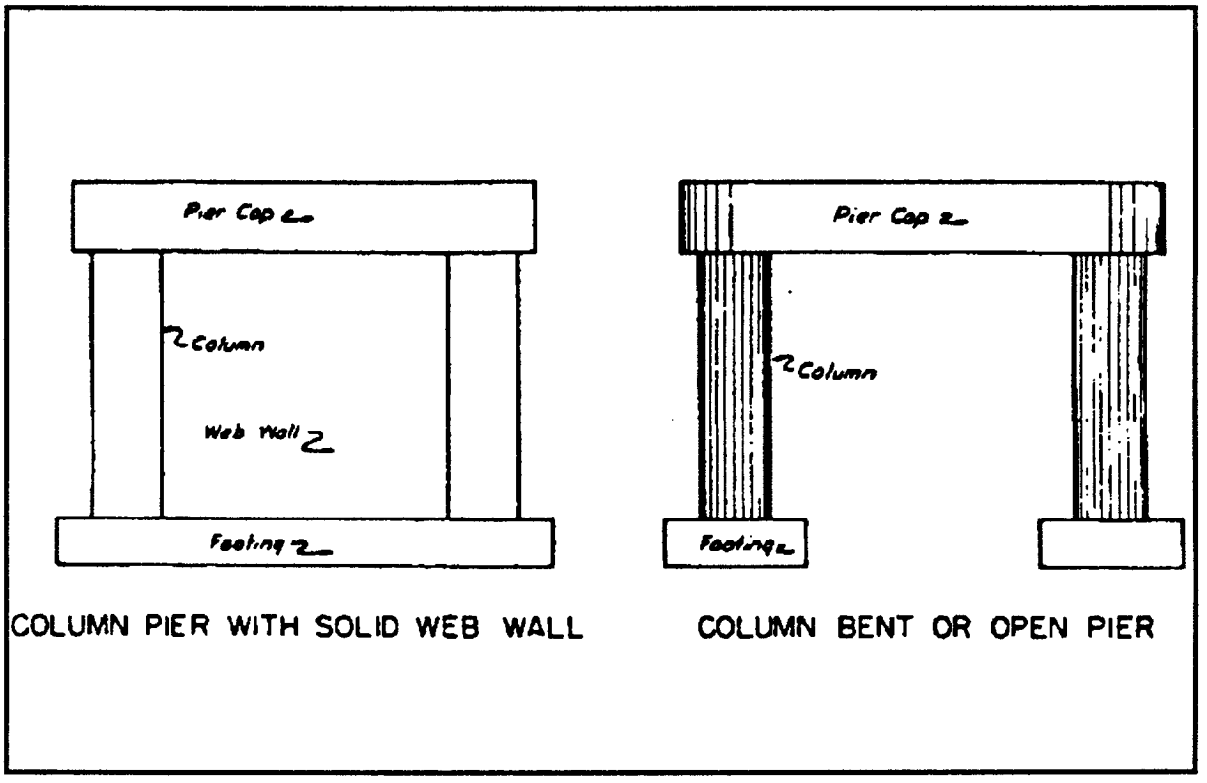

Figure l-7B
Types of Bents

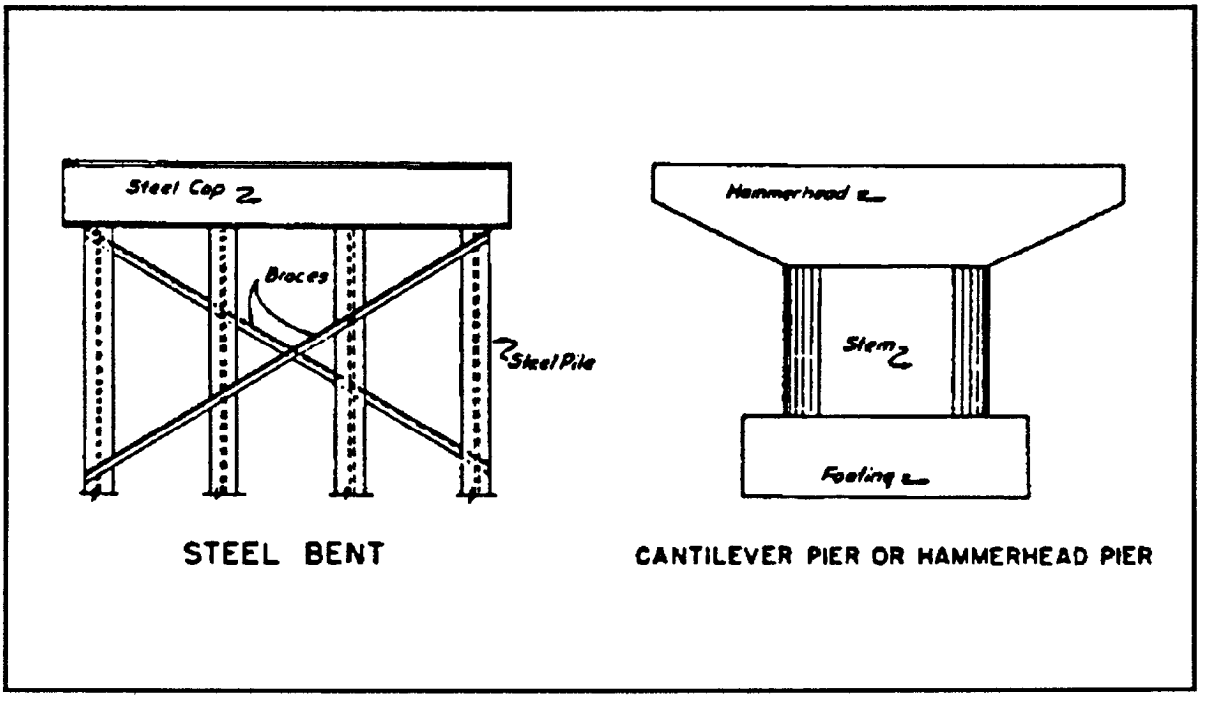

Figure 1-7C
Types of Bents

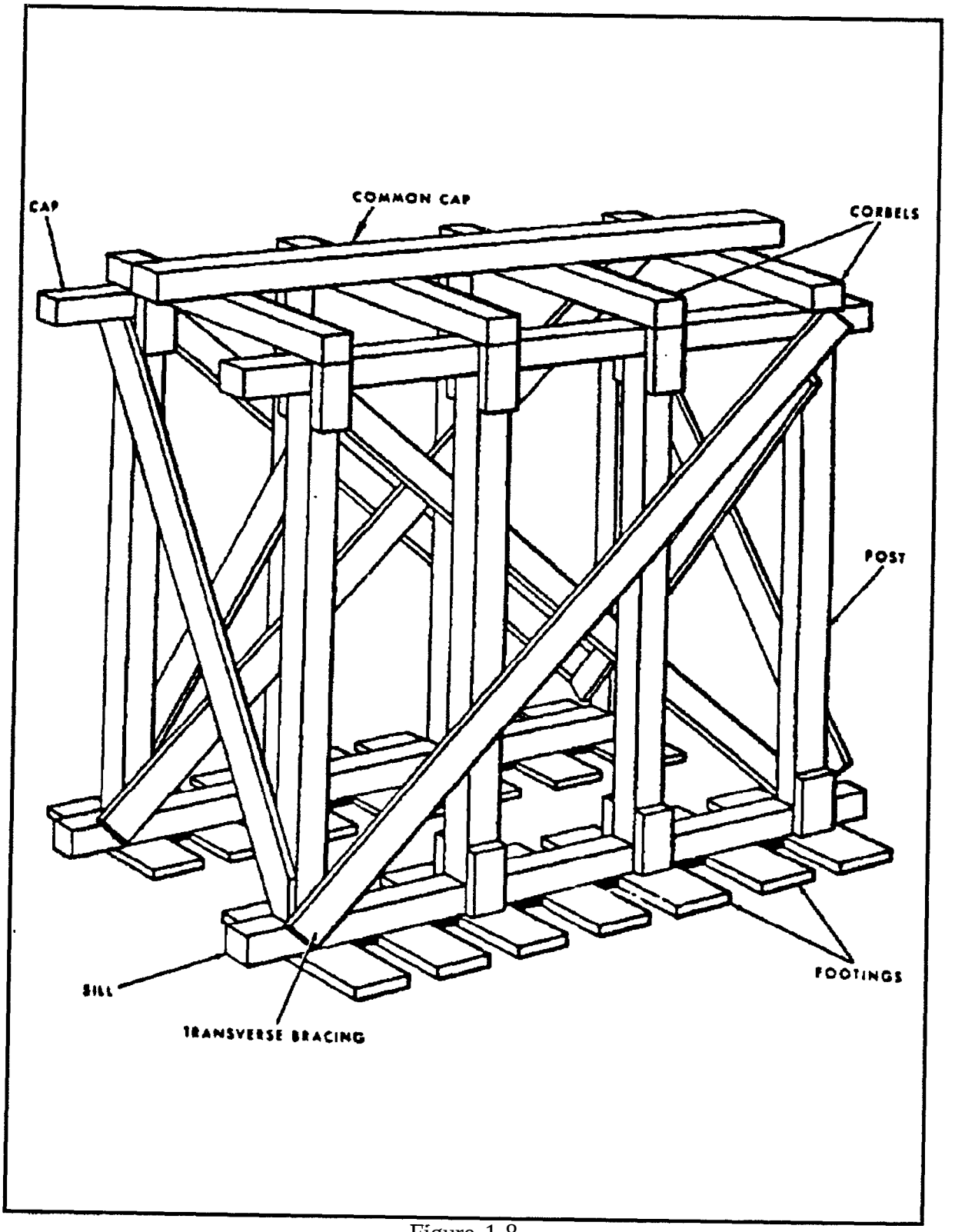

Figure 1-8
Timber Trestle Pier

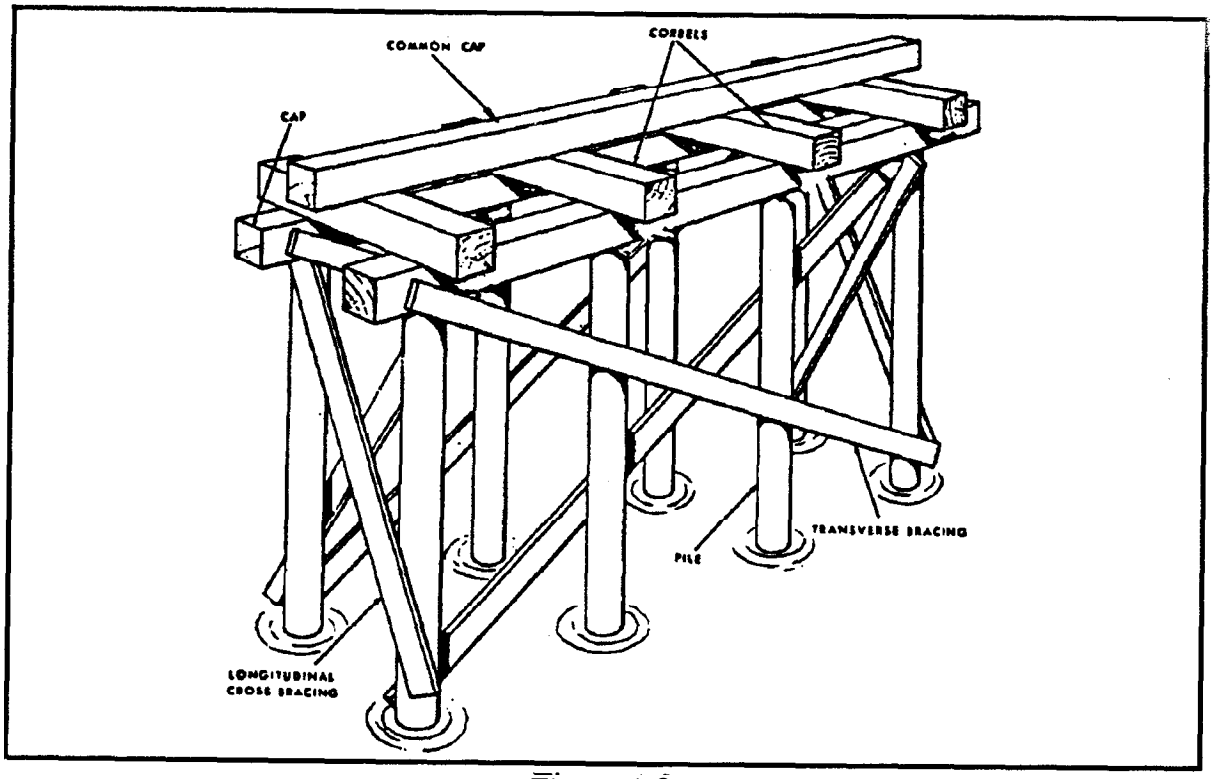

Figure 1-9
Pile Pier

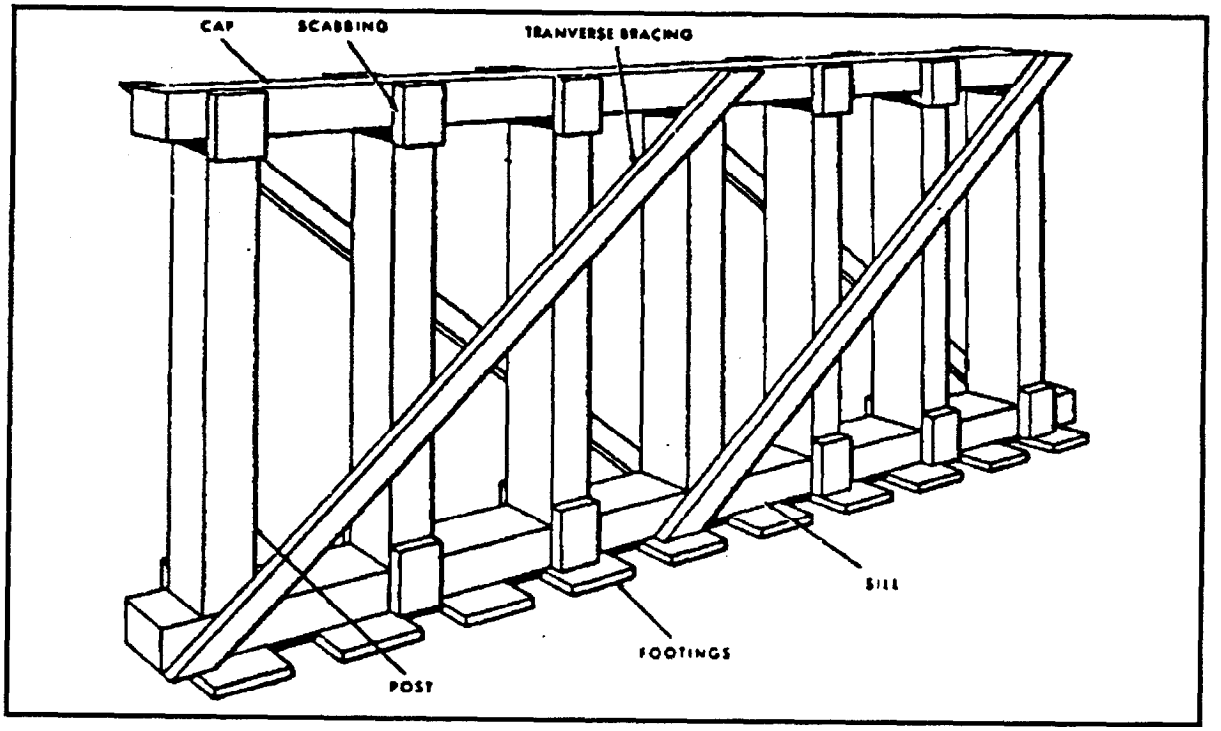

Figure 1-10
Timber Trestle Bent

1.2.3 Superstructure. The superstructure includes all elements of the structure supported by the substructure. It transfers the traffic loads to the bearings on the abutments or piers. Superstructures usually consist of the deck, a floor system, and two or more main supporting members. Figures l-11 thru l-15 show different types of superstructures.

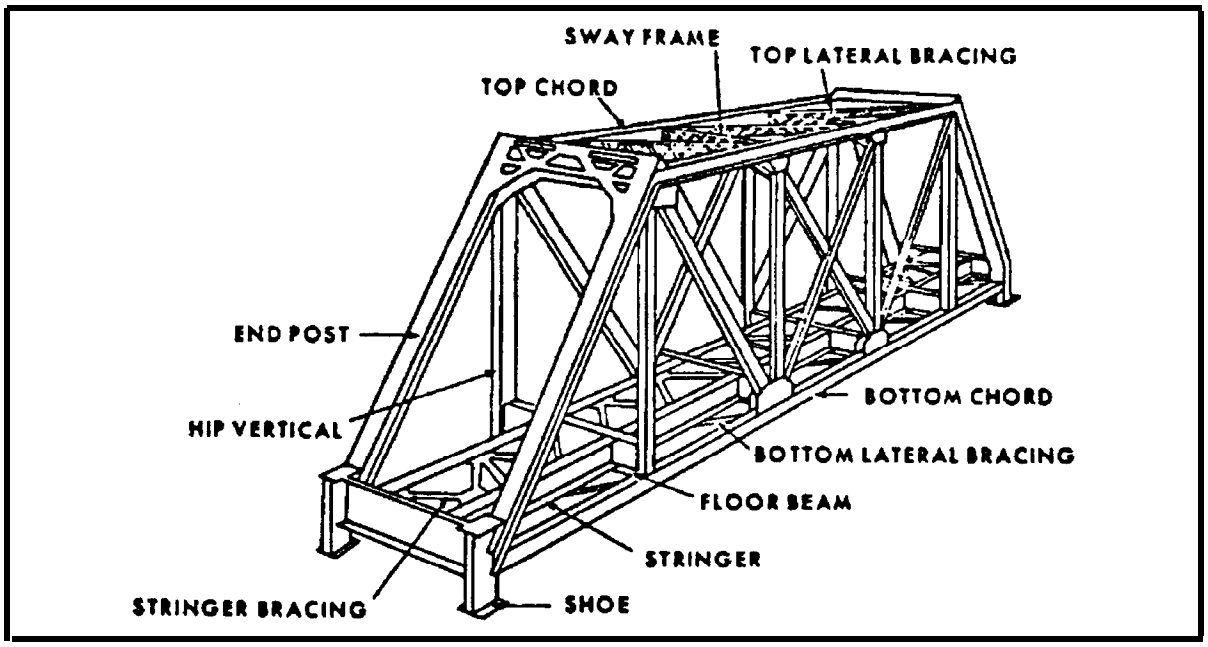

Figure 1-11
Truss Nomenclature

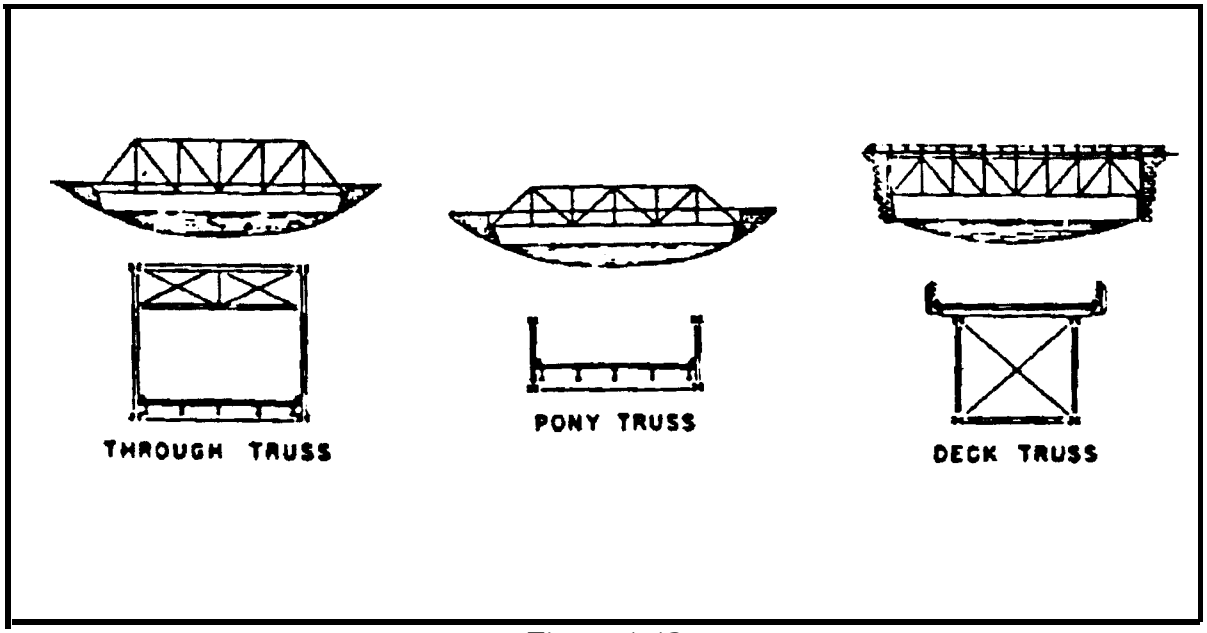

Figure 1-12
Typical Truss Bridges

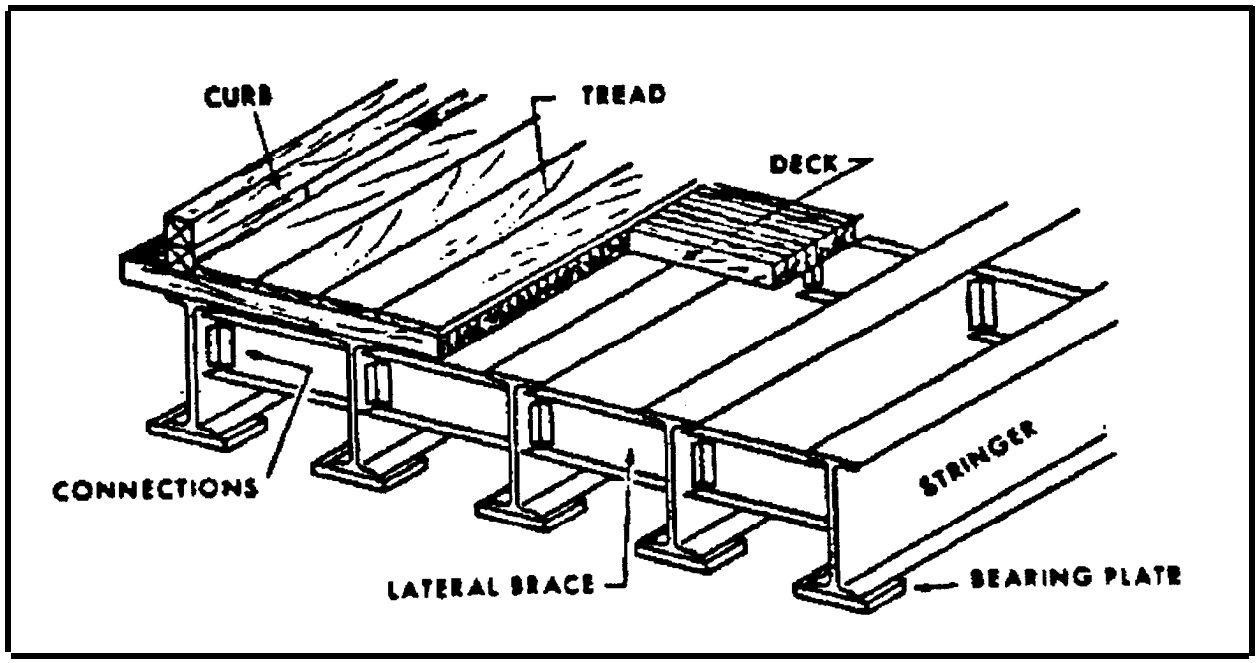

Figure 1-13
Steel Stringer Bridge Nomenclature

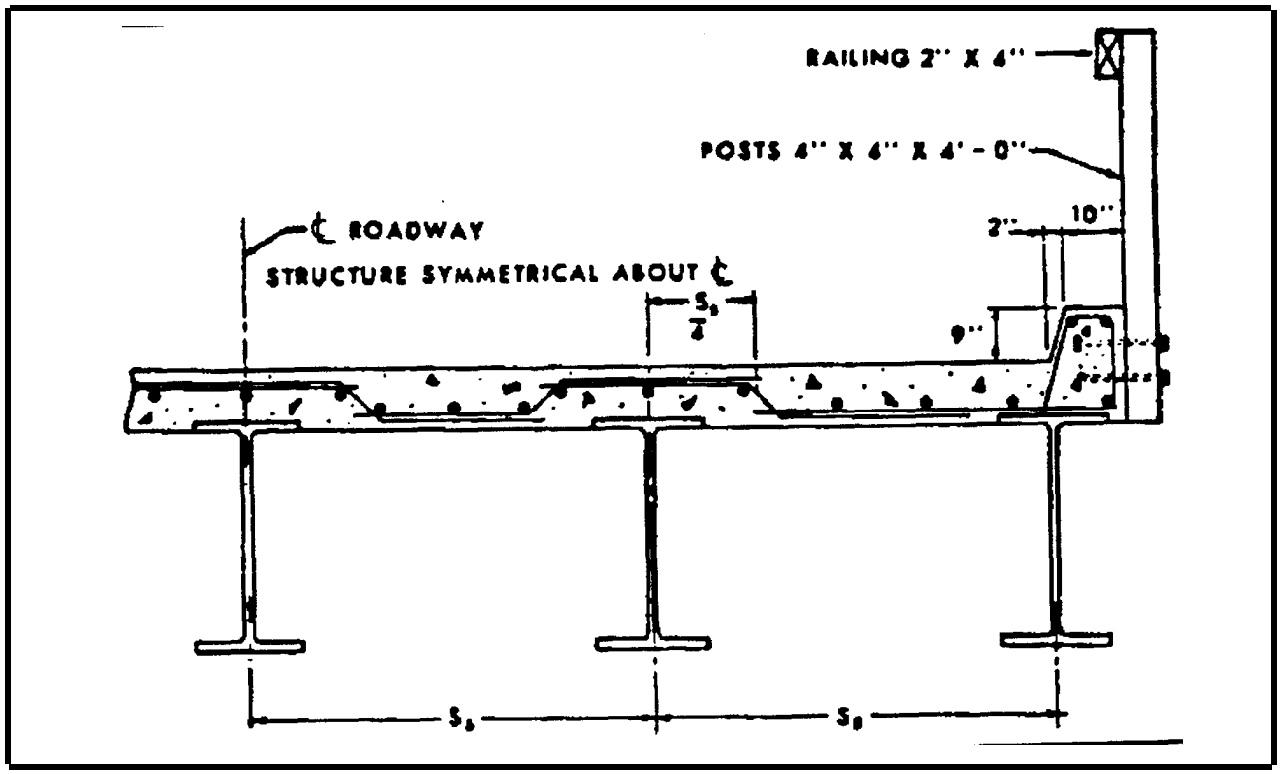

Figure 1-14
Reinforced Concrete Deck

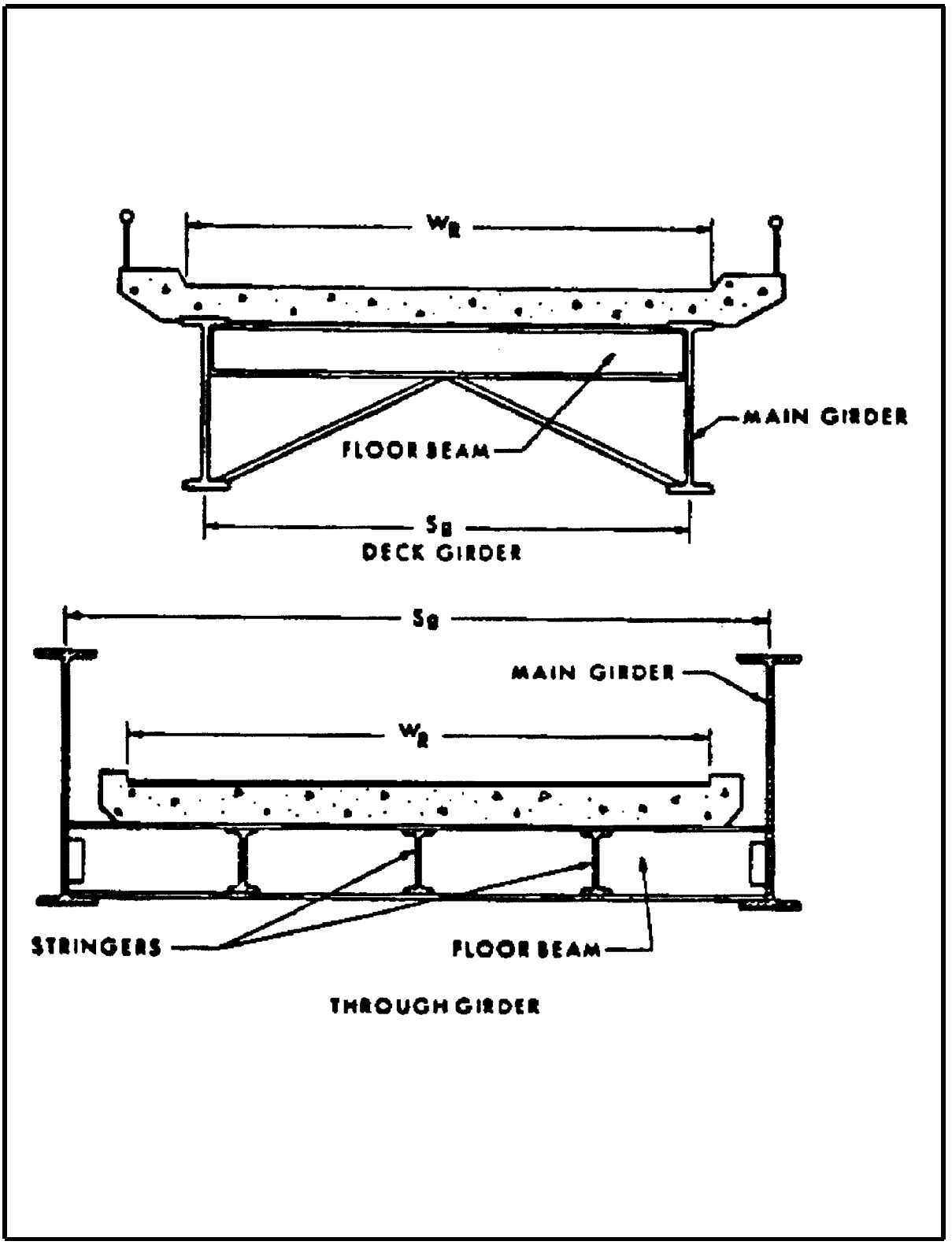

Figure l-15
Girder Bridge Cross Section

1.2.3.1 Deck. The bridge deck may be built of concrete slab, timber planking, steel grid, or steel plate. It directly supports the live load and distributes these loads to the floor system.

1.2.3.2 Floor System. The floor system may consist of either closely spaced transverse floor beams or several longitudinal stringers carried by transverse floor beams. In floors of this type, the stringers are usually wide flange beams; the floor beams may be plate girders, wide flange beams, or trusses. Where floor beams only are used, they may be rolled beams or plate girders.

1.2.3.3 Main Supporting Members. The main supporting members transmit all loads from the floor system to the superstructure. The strength and safety of the bridge structure depends primarily on the main supporting members. These members may be timber, steel, or concrete beams; steel plate girders; timber or steel trusses; steel or concrete rigid frames; arches of various material; or steel cables. Beams and girders are considered single elements while trusses have several identifiable parts. The chords, which are generally longitudinal members at the top and bottom of the truss. The verticals and diagonals of a truss are called web members.

1.2.3.4 Bracing. The individual members of beam and girder structures are braced with diaphragms and cross frames. Trusses are braced with portals, cross frames, and sway bracing. Diaphragms and cross frames stabilize the beams or trusses and distribute loads between them. A diaphragm is usually a solid web member, either of a rolled shape or built-up, while a cross frame is a truss, panel, or frame. Since portals and sway braces help maintain the cross section of the bridge, they are positioned as deep as clearance requirements permit. Portals usually are in the plane of the end posts and carry lateral forces from the top chord bracing to the supports. Lateral bracing placed at the upper or lower chords (or flanges), or at both levels, transmits lateral forces (such as wind) to the supports.

1.2.3.5 Miscellaneous. Other components of the superstructure are the curbs, scuppers, sidewalks, parapets, railings, bearings, and expansion devices. Short-span structures usually have simple sliding plates on one of the bearings to accommodate temperature induced changes in the length of the structure, whereas longer structures require rollers or rockers for this purpose. A short-span structure usually has an open slot, a slot covered with a sliding plate, or a slot filled with elastomeric joint material to provide for expansion and contraction of the deck. However, on long spans, elaborate finger joints accommodate the greater amount of movement involved.

1.3 BRIDGE MATERIALS INSPECTION GUIDANCE.

1.3.1 General. The bridge construction materials will establish the kinds of deterioration the inspector will be looking for during his inspection. Before beginning

inspection of individual elements, check the substructure and approaches for evidence of foundation failure per section 1.51. Note the condition of waterways and navigation fenders per section 1.5.20. Check bridge approaches, drainage, lighting, signing and utilities, and report any condition considered to be below acceptable standards.

1.3.2 Inspection of Concrete Structures.

1.3.2.1 Scaling. Scaling is the gradual and continuing loss of surface mortar and aggregate over an area. Describe the classification, the approximate area, and the location of the scaling. Classify scaling as follows:

- **Light Scale.** Loss of surface mortar up to 1/4 inch deep, with surface exposure of coarse aggregates.
- **Medium Scale.** Loss of surface mortar from 1/4 inch to 1/2 inch deep, with some added mortar loss between the coarse aggregates.
- **Heavy Scale.** Loss of surface mortar surrounding aggregate particles of 1/2 inch to 1 inch deep. Aggregates are clearly exposed and stand out from the concrete.
- **Severe Scale.** Loss of coarse aggregate particles as well as surface mortar and the mortar surrounding the aggregates. Depth of the loss exceeds 1 inch.

1.3.2.2 Cracking. A crack is a linear fracture in the concrete. Cracks may extend partially or completely through the concrete member. Cracks may occur in the deck, abutments and wing walls and in areas adjacent to vertical expansion joints. Cracks often appear in pier caps, parapets, T-beams, and box girders. When reporting cracks, describe their type, size, length, direction, and location. Compare the results of the current inspection with those of previous inspections to determine if crack formation is continuing or whether it has been halted. Since cracks are one of the most reliable indications of future trouble, it is important to determine their cause and extent. Classify cracks as follows:

- **Transverse Cracks:** These are fairly straight cracks that are roughly perpendicular to the center line of the roadway. Transverse cracks vary in width, length, and in spacing. They frequently occur over the main slab reinforcement on stringer bridges. Cracks may extend completely through the slab. These same cracks may extend through curbs, sidewalks, and parapets. On skewed bridges where the transverse deck steel is not placed at right angles to the roadway center line, this type of crack may appear parallel to the deck steel. On continuous structures, pronounced transverse cracking may be noted in or near the negative moment zones over the piers. Pier caps are also subject to transverse cracking.

- **Horizontal Cracking:** Cracking of this kind will occur in walls, abutments, pier stems, and columns. They are similar in nature to transverse cracks, and may be listed as such.
- **Longitudinal Cracks:** These are fairly straight cracks (in slabs) running parallel to the center line of the roadway. They are of variable widths, lengths, and spacings. These cracks may extend partially or completely through the deck.
- **Vertical Cracks:** Vertical cracks in wall, abutments, pier stems and caps are similar to longitudinal cracking in slabs, and should be described as such.
- **Diagonal Cracks:** These cracks appear roughly parallel in slabs skewed to the center line of the bridge. They are usually shallow and are of varying lengths, widths and spacings. When found in the vertical faces of beams or pier caps, they may be deeper than usual, and thus pose a more serious problem.
- **Pattern or Map Cracking:** These interconnected cracks form networks of varying size and appear similar to that of sun-cracking seen on dried flats. They vary in width from barely visible, fine cracks to well defined openings. They are found in both slabs and walls.
- **D-cracks: These** are usually defined by dark colored deposits, generally near joints and edges. They may widen gradually and eventually produce failure. Vertical cracks near vertical expansion joints in abutments and walls can also be classified as D-cracks. This type of cracking may be indicative of alkali reactive concrete.
- **Random Cracks:** These are meandering, irregular cracks appearing on the surface of slabs. They have no particular form and do not logically fall into any of the classifications described above.

1.3.2.3 Spalling. Spalling is a roughly circular or oval depression in the concrete. It is caused by the separation and removal of a portion of the surface concrete revealing a fracture roughly parallel, or slightly inclined, to the surface. Usually, a portion of the depression rim is perpendicular to the surface. Often reinforcing steel is exposed. Spalling may be classified as follows:

- **Small:** Not more than inch deep or approximately six inches in diameter.
- **Large:** More than 1 inch deep and greater than 6 inches in diameter.

- **Hollow Area:** An area of concrete which gives off a hollow sound when struck with a hammer or steel bar, indicating the existence of a fracture plane below the surface.

1.3.2.4 Joint Spall. This is an elongated depression along the expansion, contraction, or construction joint.

1.3.2.5 Pop-Outs. These are conical fragments that break out of the surface of the concrete leaving small holes. Usually, a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone.

1.3.2.6 Mudballs. These are small holes that are left in the surface by the dissolution of clay balls or soft shale particles.

In recording the last four defects, describe the type, depth, dimension, and location together with a sketch, drawing, or photograph, as appropriate.

1.3.3 Inspection of Steel Structures.

1.3.3.1 Rust. Rusted steel varies in color from dark red to dark brown. Initially, rust is fine grained, but as it progresses it becomes flaky or scaly in character. Eventually, rust causes a pitting of the member. Note the location, characteristics, and the extent of the rusted areas. Note the depth of heavy pitting and record the size of any perforation caused by rusting. Classify rust as follows:

- **Light:** A light, loose rust formation pitting the paint surface.
- **Moderate:** A looser rust formation with scales or flakes forming. Definite areas of rust are discernible.
- **Severe:** A heavy, stratified rust or rust scale with pitting of the metal surface. This rust condition eventually culminates in the perforation of the steel section itself.

1.3.3.2 Cracks. Cracks in the steel may vary from hairline thickness to sufficient width to transmit light through the member. Any type of crack is obviously serious and should, be reported at once. Record the location and length of all cracks and indicate whether the cracks are open or closed.

1.3.3.3 Buckles and Kinks. These conditions develop mostly because of damage arising from thermal strain, overload, or added load conditions, caused by the failure or the yielding of adjacent members or components. Collision damage may also cause buckles, kinks and cuts. Look for cracks radiating from cuts or notches. Note the members damaged, the type, location, and extent of the damage, and measure the amount of deformation, if possible.

1.3.3.4 Stress Concentrations. Observe the paint around the connections at joints for fine cracks indicating large strains due to stress concentrations. Be alert for sheared or deformed bolts and rivets.

1.3.3.5 Encased Steel. Inspect structural steel partially encased in substructure concrete at the face of exposure for deterioration and for movement.

1.3.3.6 Galvanic Corrosion. This condition will appear essentially similar to rust.

1.3.4 Inspection of Timber Structures.

1.3.4.1 Fungus Decay. Classify fungus decay as follows:

- **Mild:** Mild fungus decay appears as a stain or discoloration. It is hard to detect and even harder to distinguish between decay fungi and staining fungi.
- **Advanced:** Wood darkens further and shows signs of definite disintegration, with the surface becoming punky, soft and spongy, stringy, or crumbly. Fruiting bodies of fungi (mushrooms), similar to those seen on old stumps may develop. Note the location, depth of penetration, and size of the areas of decay. Where decay occurs at a joint or splice, indicate the effect on the strength of the connection. Use a knife, ice pick, or an increment borer. to test for decayed wood. Decay is very likely to occur at connections, splices, support points, or around bolt holes. This may be due either to the tendency of such areas to collect and retain moisture, or to penetration of the preservative treatment. Unless these surfaces are subsequently protected, decay is very likely. Note any holes, cuts, scrapes or other breaks in the timber surface which would break the protective layers of the preservative treatment.

1.3.4.2 Insects. Record the location and extent of damage. Estimate whether extermination is feasible or if member replacement is necessary.

- **Termites:** All damage is inside the surfaces of the wood; hence, it is not visible. White mud shelter tubes or runways extending up from the earth to the wood and on the sides of masonry substructures are the only visible signs of infestation. If the timber members exhibit signs of excessive sagging or crushing, check for termite damage with an ice pick or an increment borer.
- **Powder-Post Beetles:** The outer surface is pocked with small holes. Often a powdery dust is dislodged from the holes. The inside may be completely excavated.

- **Carpenter Ants:** Accumulation of sawdust on the ground at the base of timber. Large, black ants may be seen in the vicinity of the infested wood.

1.3.4.3 Marine Borers. Damage from marine borers will usually be most severe in the area between high and low water, but may extend to the mud line. Where piles are protected by concrete or metal shielding, inspect the shields for cracks or holes that would permit entrance of the borers. Unplugged bolt holes also permit entrance of these pests. In such cases, there are often no outside evidences of borer attack. List the locations and extent of damage and indicate whether it is feasible to exterminate the infestation and strengthen the member or if immediate replacement is necessary.

- **Mollusk (Shipworms):** The most common species of shipworm is the teredo. This shipworm enters the timber in an early stage of life and remains there for the rest of its life. Teredos reach a length of 15 inches and a diameter of 3/8 inch, although some species of shipworm grow to a length of 6 feet. The teredo maintains a small opening in the surface of the wood to obtain nourishment from the sea water.
- **Crustacean Borers:** The most commonly encountered crustacean borer is the limnoria or wood louse. It bores into the surface of the wood to a shallow depth. Wave action or floating debris breaks down the thin shell of timber outside the borers' burrows, causing the limnoria to burrow deeper. The continuous burrowing results in a progressive deterioration of the timber pile cross section which will be most noticeable by the hour glass shape developed between the tide levels.

1.3.4.4 Weathering and Miscellaneous Damage. Record the extent and classification of weathering and miscellaneous damage. Classify as follows:

- **Slight:** Surfaces of wood are rough and corrugated, and the members may even warp.
- **Advanced:** Large cracks extend deeply or completely through the wood. Wood is crumbly and obviously deteriorated (similar to tips of roof shingles at the eaves).
- **Chemical Attack:** This will resemble decay.
- **Fire:** Fire damage is easily recognized. Usually this type of damage will have been reported prior to the inspection.
- **Mechanical Wear:** Wear due to abrasion is readily recognized by the gradual loss of section at the points of wear. Report the location, the general area subject to wear, and the loss in thickness.

Indicate whether immediate remedial action is necessary.

- **Collision:** Shattered or injured timbers are indications of collision. Give location and extent of damage and determine whether immediate measures are needed.
- **Holes:** Report unplugged holes, such as those left by test borings, nails, bolts, and the like.

1.3.5 Inspection of Wrought And Cast Iron. Inspect wrought iron and cast iron structures similarly to a steel structure. Cast iron is subject to defects such as checks (cracking due to tensile cooling stresses) and blowholes. The latter has a serious effect on both the strength and toughness of the material.

1.3.6 Inspection of Stone Masonry Structure. Note the location and extent of the following defects:

- **Weathering:** The hard surface degenerates into small granules, giving stones a smooth, rounded look.
- **Spalling:** Small pieces of rock break out or chip away.
- **Splitting:** Seams or cracks open up in rocks, eventually breaking them into smaller pieces.

1.3.7 Inspection of Aluminum Structures.

1.3.7.1 Cracking: Aluminum may be subject to some fatigue cracking. Aluminum members should be examined in areas near the bases of cantilever arms and in areas near complex welded and riveted connections. Weld cracking often occurs on sign bridges near those joints which are subject to high stresses because of the misalignment of prefabricated sections. The combination of high stresses and wind vibration produces fatigue.

1.3.7.2 Pitting: Aluminum will pit slightly, but this condition rarely becomes serious.

1.4 INSPECTION OF BRIDGE ELEMENTS.

1.4.1 Initial Inspection. Foundation movements may often be detected by first looking for geometry deviations. With the exception of curved structures, haunched members, and steeply inclined bridges, members and lines should usually be either parallel or perpendicular to each other. While not always practical, especially for bridges spanning large bodies of water or for those located in urban industrial areas, careful observation of the overall structure for lines that seem incongruous with the rest of the bridge is a good starting point. For a more detailed inspection, the following methods are often useful:

1.4.1.1 Check the Alignment: Any abrupt change or kink in the alignment of the bridge may indicate a lateral movement of a pier or of bearings. Older bridges are particularly vulnerable to ice pressures which can cause structural misalignment.

1.4.1.2 Sight Along Railings: A sudden dip in the rail line is often the result of settlement of a pier or abutment.

1.4.1.3 Run Profile Levels Along the Centerline and/or the Gutter Lines: This technique will help to establish the existence of any settlement, and also identify differential settlements across the roadway. Normally this kind of inspection technique will be employed only for large bridges or where information concerning the extent and character of differential settlement movement is required.

1.4.1.4 Check Piers, Pile Bents, and Abutment Faces for Plumbness with a Transit: An out-of-plumb pier in either direction usually means foundation movement. It may also indicate a superstructure displacement. For small bridges and for preliminary checks, use a plumb bob.

1.4.1.5 Observe the Inclination of Expansion Rockers or Roller Movements: Rocker inclinations inconsistent with seasonal weather conditions may be a sign of foundation or superstructure movement. Out-of-plumb hangers on cantilevered structures also indicate foundation shifting.

1.4.1.6 Observe Expansion Joints at Abutments and Walls: Observe the expansion joints for signs of opening or rotating. These conditions may indicate the movement of subsurface soil or a bearing failure under one of the footings.

1.4.1.7 Check Deck Joints and Finger Dams: Abnormally large or small openings, elevation differential, or jamming of the finger dams can be caused by substructure movements. Soil movements under the approach fills are also frequent occurrences.

1.4.1.8 Check Backwalls and Beam Ends: Check the backwalls for cracking which may be caused by either abutment rotation, sliding, or pavement thrust. Check for beam ends which are bearing against the backwall. This condition is a sign of horizontal movement of the abutment.

1.4.1.9 Observe Slabs, Walls and Members: Cracks, buckling and other serious distortions should be noted. Main members, secondary members and bracing should be scrutinized for distortion.

1.4.1.10 Observe Fill and Excavation Slopes: Slide scarps, fresh sloughs, and seepage are indications of past or imminent soil movement.

1.4.1.11 Check for Scour: See Inspection of Waterways, section 1.23

1.4.1.12 Unbalanced Post-Construction Embankment or Fills: Check embankments or fills for balance and positioning. Unbalanced embankments can cause soil movements which may impair the structural integrity of the bridge.

1.4.1.13 Underwater Investigation of All Piling and Pile Bents: Underwater investigation of piling and pile bents should be undertaken periodically. Check all timber piles for insect attack and deterioration. Examine steel piles well below the water surface. Steel piles protected in the splash zone can rust between the concrete jacket and the mud line. Examine pre-stressed piles below water for cracking or splitting.

1.5 INSPECTION OF ABUTMENTS.

1.5.1 Drainage: Check that drains and weep holes are clear and functioning properly. Water seeping through joints and cracks may indicate accumulation of water behind the abutment. Report frozen or plugged weep holes. Mounds of earth immediately adjacent to weepers may indicate the present of burrowing animals. (Figure 1-16)

1.5.2 Erosion/Scour: Check for scour or erosion around and/or beneath the footing and for evidence of any movement or settlement.

1.5.3 Bearing Seats: Check bearing seats for cracking and spalling, especially near the edges. This is particularly critical where concrete beams bear directly on the abutment. Check bearing seats for presence of debris and standing water. (Figure 1-16)

1.5.4 Deterioration: Check for deteriorating concrete in areas that are exposed to roadway drainage, especially where deicing chemicals are used.

1.5.5 Back Walls: Check backwalls for cracking and possible movement. Particularly check the construction joint between the backwall and the abutment. Open cracks, off-centered bearings or inadequate or excessive clearances between girder ends and back wall indicate movement. (Figure l-16).

1.5.6 Masonry: Check stone masonry for mortar cracks, vegetation, water seepage through the cracks, loose or missing stones, weathering, and spalled or split blocks.

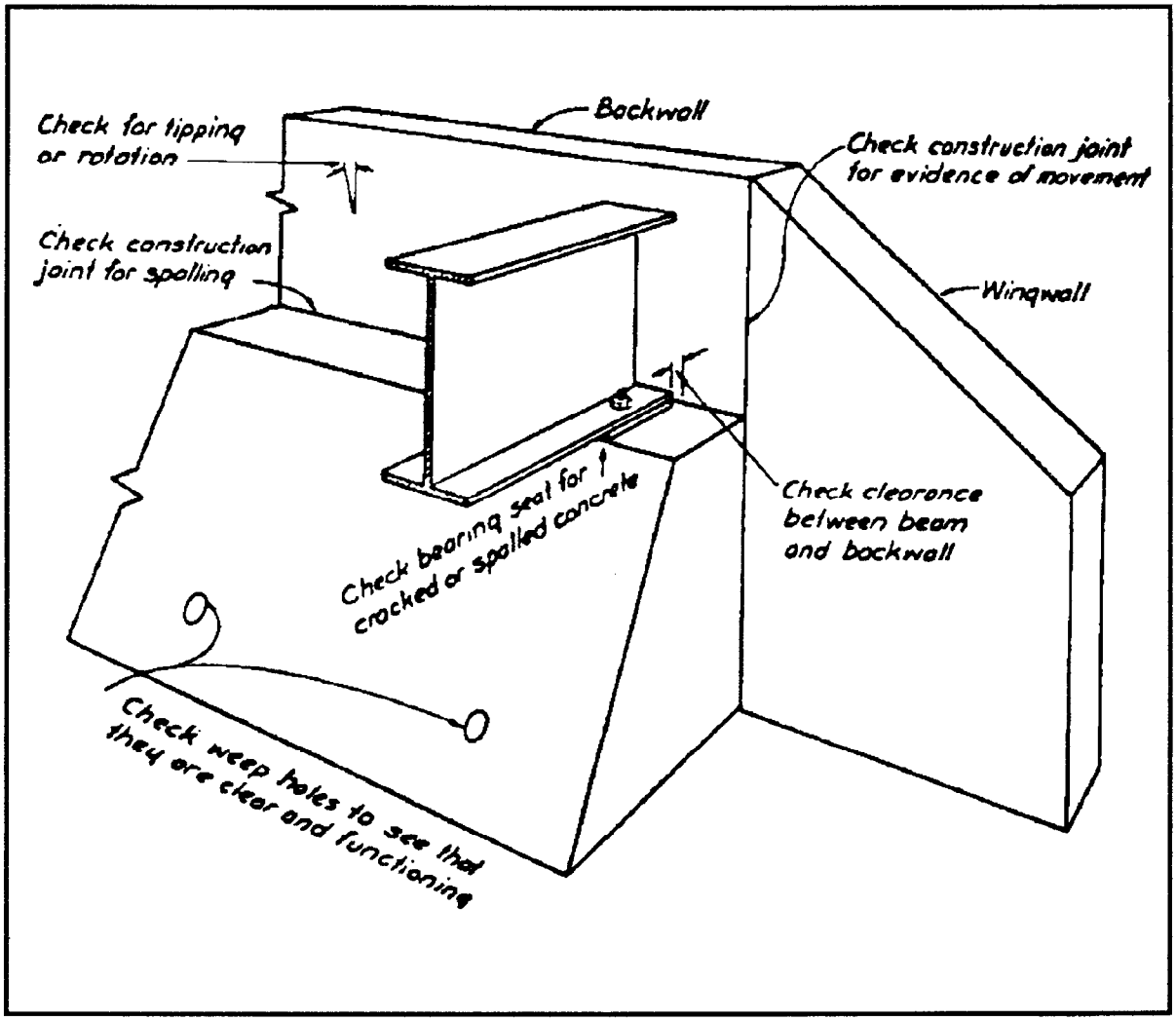

Figure 1-16
Abutment Checklist

1.6 INSPECTION OF RETAINING WALLS: Inspection of most retaining walls should be similar to that of an abutment.

1.6.1 Crib Walls: Crib type retaining walls are subject to similar deterioration and damage as other wood, concrete, and steel structures.

1.6.1.1 Settlement: Settlement of the soil under the embankment will lead to distortion and possible crib wall damage. If sufficient movement occurs, the wall may fail.

1.6.1.2 Timber Cribs: Timber cribs may decay or be attacked by insects. Preservative treatments usually are very effective in protecting the wood in contact with the soil.

1.7 INSPECTION OF PIERS AND BENTS.

1.7.1 Erosion: Check for foundation undermining by erosion or scour, and for exposed piles (Figure 1-17). Check for evidence of tilt or settlement.

1.7.2 Concrete Deterioration: Check for concrete deterioration, in the splash zone, at the water line, at the ground line, and wherever concrete is exposed to roadway drainage.

1.7.3 Concrete Cracks: Check the pier columns and the pier caps for cracks.

1.7.4 Bearing Seats: Check the bearing seats for corrosion, debris, cracking, and spalling.

1.7.5 Masonry: Check stone masonry piers and bents for mortar joint loss and cracks, water and vegetation in the cracks, and for spalled, split, loose, or missing stones.

1.7.6 Rust: Check steel piers and bents for corrosion (rust), especially at joints and splices. Bolt heads, rivet heads, and nuts are very vulnerable to rust, especially if located underwater or in the base of a column.

1.7.7 Grout Pads: Examine grout pads and pedestals for cracks, spalls or deterioration.

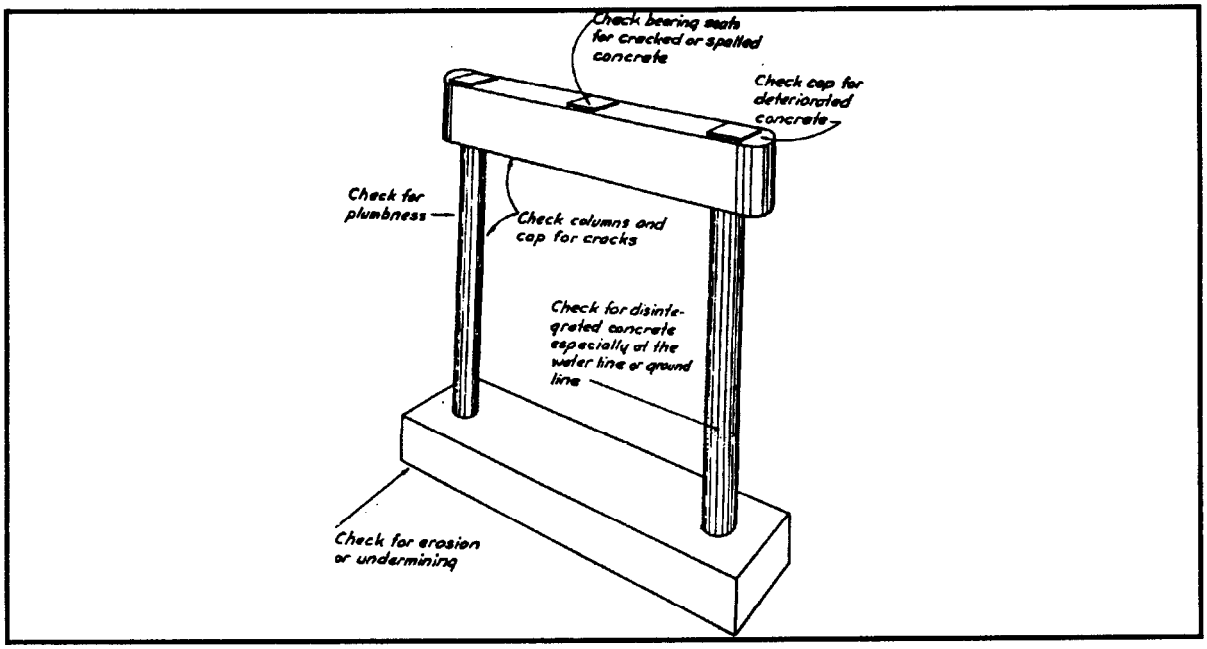

Figure 1-17
Concrete Pier and Bent Checklist

1.7.8 Splash Zone: Examine steel piles both in the splash zone and below water surface.

1.7.9 Clearance: Investigate any significant changes in clearance for pier movement.

1.7.10 Damage: Check all pier and bent members for structural damage caused by collision or over stress.

1.7.11 Steel Cracking: Where a steel cap girder and continuous longitudinal beams are framed together, check the top flanges, welds, and webs for cracking.

1.7.12 Movement Under Load: Observe and determine whether unusual movement occurs in any of the bent members during passage of heavy loads.

1.7.13 Earth Loads: Determine whether any earth or rock fills have been piled against piers causing loads not provided for in the original design.

1.7.14 Rocker Mechanisms: Where rocker bents are designed to rotate freely on pins and bearings, check to see that such movement is not restricted. Lack of movement can be caused by severe corrosion or the presence of debris.

1.8 INSPECTION OF PILE BENTS.

1.8.1 Concrete: Check for the same items as discussed in section 1.7, Inspection of Piers and Bents.

1.8.2 Timber:

1.8.2.1 Decay: Check for decay in the piles and bracing (Figure 1-18). Check for presence of insect damage and marine borers. (See section 1.3.4.2 & 1.3.4.3) The presence of decay may be determined by tapping with a hammer or by test boring the member. Check particularly at the ground line, or water line, and at joints, splices, checks and holes.

1.8.2.2 Splices and Connections: Check splices and connections for tightness and for loose or missing bolts.

1.8.2.3 Cap: Check the condition of the cap at those points where the beams bear directly upon it, and at those points where the cap bears directly upon the piles. Note particularly any splitting or crushing of the timber in these areas.

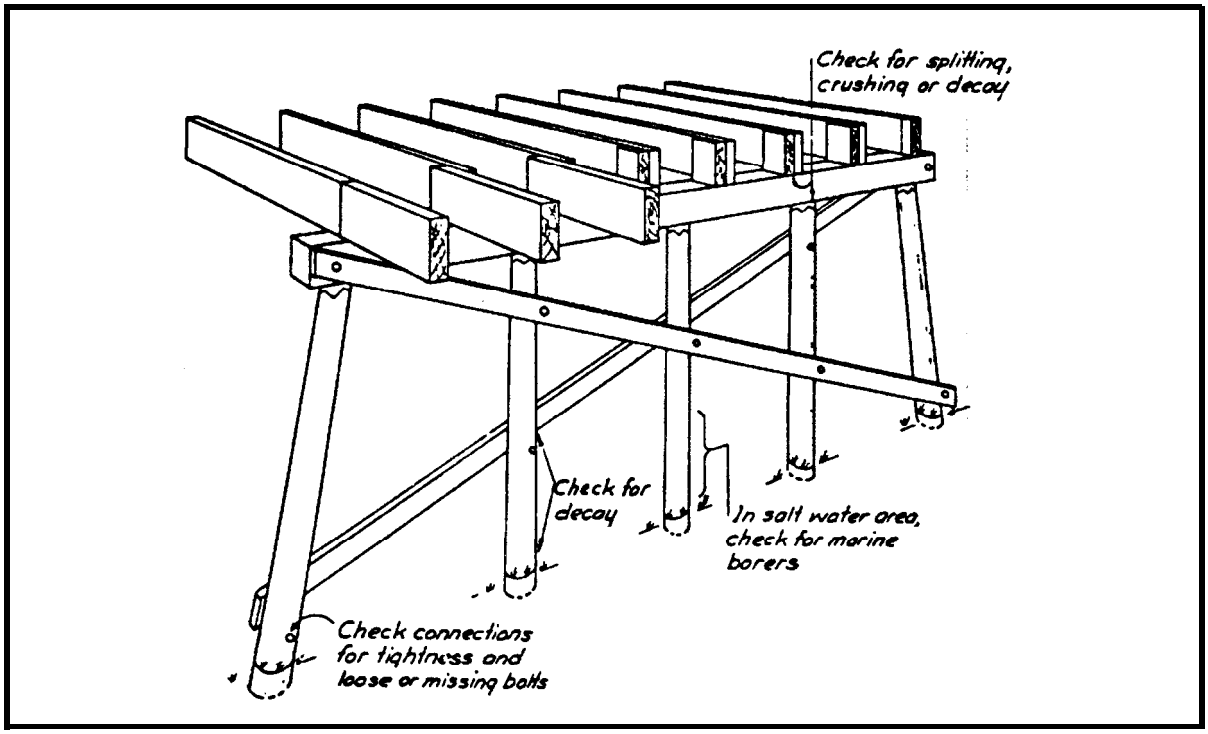

Figure 1-18
Timber Bent Checklist

1.8.2.4 Caps Under Heavy Loads: Observe caps that are under heavy loads for excessive deflection.

1.8.2.5 Rotted or Damaged Timbers: Check for rotted or damaged timbers in the backwalls of end bents (abutments), especially where such conditions would allow earth to spill upon the caps or stringers. Approach fill settlement at end bents may expose short sections of piling to additional corrosion or deterioration.

1.8.2.6 Checks, Splits and Grain Slope: Check members for excessive checks, splits and grain slope. Check for excessive and loose knots.

1.8.2.7 Marine Borers: In marine salt water environments, check wood piles for marine borer infestation damage, especially at mud line and areas exposed to scour below the mud line.

1.8.3 <u>Steel:</u>

1.8.3.1 Rust: Check for the presence of rust, especially at the ground level line. Use a chipping hammer if necessary to determine the extent of rust. Over water crossings, check the splash zone (2 feet above high tide or mean water level) and the submerged part of the piles for indications of rust.

1.8.3.2 Debris: Check for debris around the pile bases. Debris will retain moisture and promote rust.

1.8.3.3 Steel Caps. Check the steel caps for rotation due to eccentric connections.

1.8.3.4 Bracing: Check the bracing for broken connections and loose rivets or bolts.

1.8.3.5 Web Stiffeners: Check condition of web stiffeners.

1.8.3.6 Protective Coatings: Check condition of all protective coatings.

1.8.3.7 Cathodic Protection Systems. Check operating condition of cathodic protection systems if applicable.

1.9 INSPECTION OF CONCRETE BEAMS AND GIRDERS.

1.9.1 All Beams:

- Check for spalling concrete, giving special attention to points of bearing where friction from thermal movement and high edge pressure may cause spalling (Figure 1-19).
- Check for diagonal cracking, especially near the supports. Diagonal cracks on the side of the beam may indicate incipient shear failure. Cantilever box girder bridges, whether of prestressed or reinforced concrete, utilize a shiplapped joint in which the suspended span rests upon bearings located on the anchor span. Inspect shiplap cantilevers with re-entrant corners carefully for signs of cracking or other deterioration.
- Check for flexure (vertical) cracks or disintegration of the concrete around tension steel. Discoloration of the concrete surface may be an indication of concrete deterioration or the corrosion of the reinforcing steel. In severe cases, the reinforcing steel may become exposed.
- Observe areas that are exposed to roadway drainage for disintegrating concrete.
- Check for damage caused by collision or fire.
- Note any excessive vibration or deflection.
- Check for horizontal web cracks, especially at top flange to slab connection area on T beams.

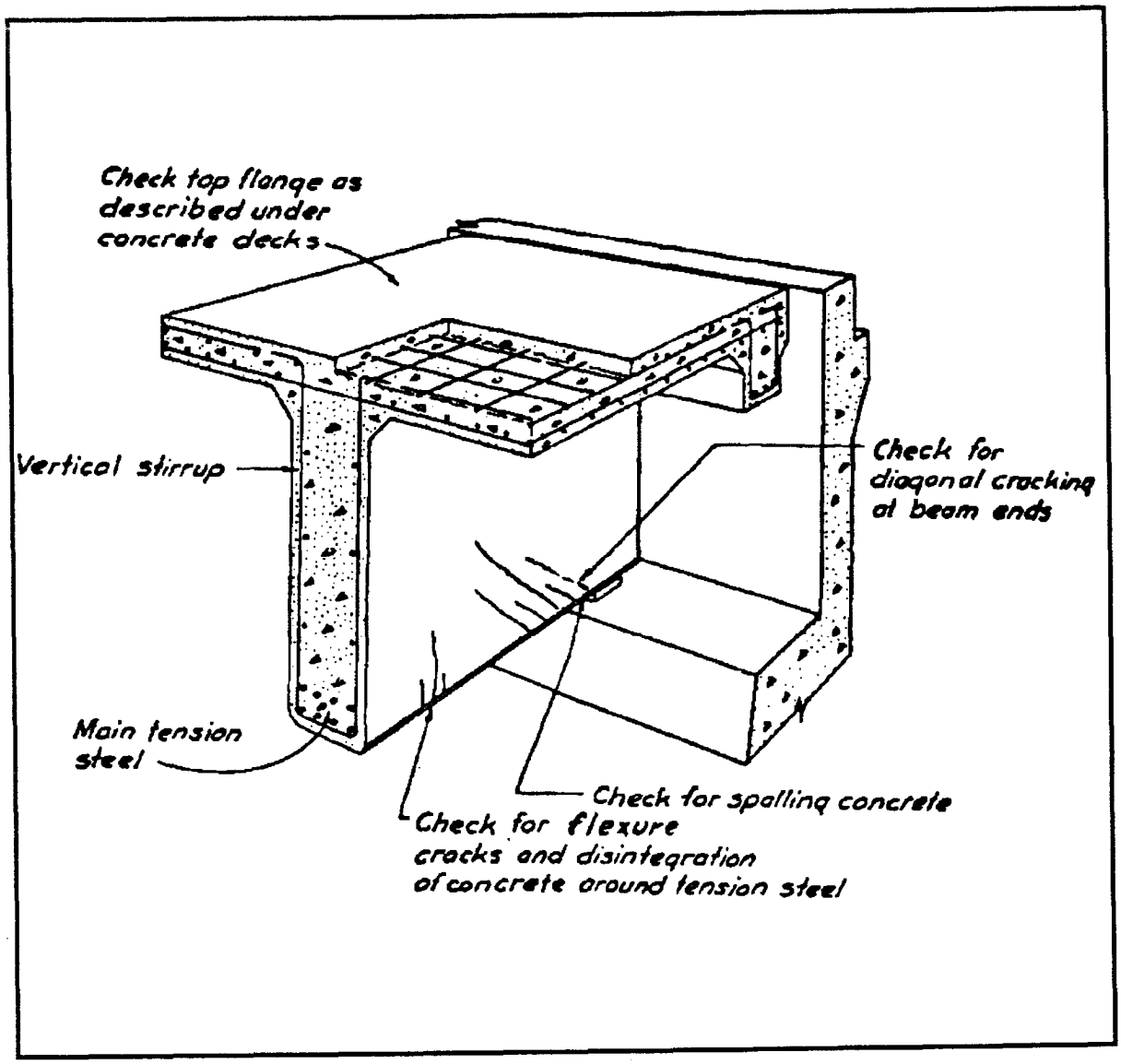

Figure 1-19
Concrete Beam Checklist

1.9.2 Box Girders:

- Examine the inside of box girders for cracks and to see that the drains are open and functioning properly.
- Check the soffit of the lower slab and the outside face of the girders for excessive cracking.
- Check diaphragms for cracks.
- Examine the underside of the slab and top flange for scaling, spalling, and cracking.

- Note any offset at the hinges which might indicate problems with the hinge bearing. An abnormal offset should be investigated further to determine the cause and the severity of the condition.

1.9.3 Prestressed Concrete Bridges:

- Check for longitudinal cracks on all flange surfaces. This may occur on older prestressed bridges where insufficient stirrups were provided.
- Examine the alignment of prestressed beams.
- Check for cracking and spalling in the area around the bearings and at the cast-in-place diaphragms for differential creep. On pretensioned deck units check the underside during the passage of traffic to see whether any unit is acting independently of the others.

1.10 INSPECTION OF STEEL BEAMS AND GIRDERS.

1.10.1 Corrosion: Inspect steel for corrosion and deterioration (Figure l-20) especially at connections and places where two plates are in face to face contact. Check under the deck joints and at any other points that may be exposed to roadway drainage. If rusting and deterioration is evident, check the members for possible reduced cross sectional area, using calipers, rulers, corrosion meters, or section templates. Check for spreading of plates or member movement resulting from corrosive expansion forces.

1.10.2 Rivets and Bolts: Examine areas around rivets or bolts and along the seams of builtup members and splices for deterioration and signs of slippage.

1.10.3 Debris: Check members for cleanliness and freedom from debris, especially on the top side of the bottom flange and at the ends of beams.

1.10.4 Cracks:

- Examine welds, weld terminations, and adjacent metal for cracks, particularly at unusual types of weld connections or connections to which access would have been difficult for the welder. Check around moment connections and discontinuities such as copes, cuts and sudden changes in cross-section or configuration.
- Check floor beam to girder connections, brackets, moment splices and joints in rigid frame structures.
- Check welded built-up girders and beams at top flange to web connection and at vertical and longitudinal stiffeners.
- Check areas where vibration and movement could produce fatigue stress.

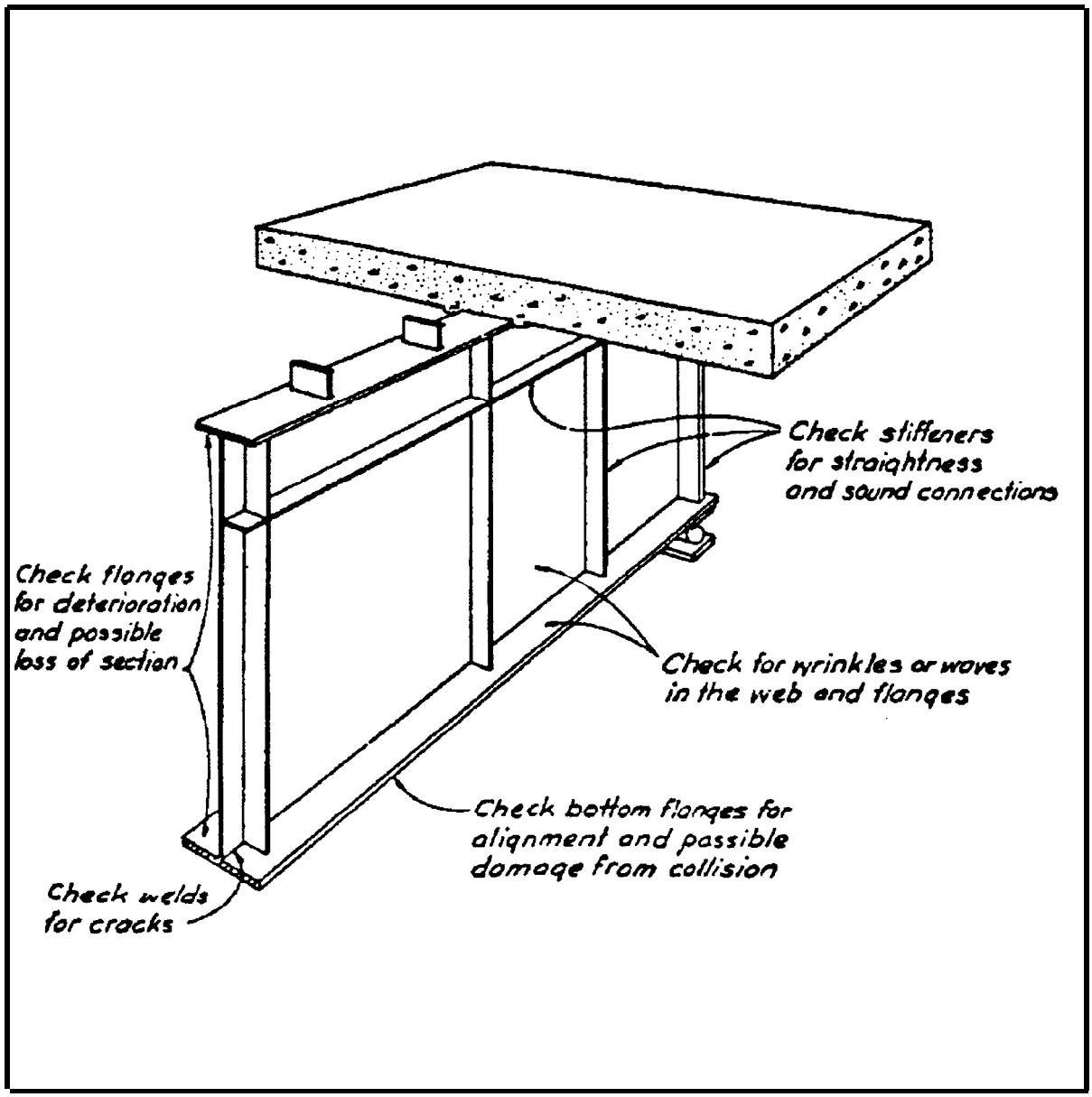

Figure 1-20
Steel Beam Checklist

1.10.5 Alignment: Check the general alignment by sighting along the members. Misalignment or distortion may result from over stress, collision or fire damage. If such a condition is present, its effect on structural safety of the bridge should be fully investigated.

1.10.6 Buckled Members: Check for wrinkles, waves, cracks, or damage in the web and flanges of steel beams, particularly near points of bearing. Check the stiffeners for straightness and determine whether their connections are broken, buckled, or pulled from the web. Check gussets, diaphragms and bracing.

1.10.7 Vibration: Observe any unusual vibration or excessive deflections under the passage of heavy loads.

1.10.8 Hinges and Hangers: On cantilevered bridges, check hinges and hangers to see that they are functioning freely and without restraint. Where a hanger has one end fixed rigidly to a web by welding or bolting, to develop an eccentric hinge, it will develop both bending and axial stresses. Examine the web and the hanger adjacent to the fixed end for cracking.

1.10.9 Wind Locks: Check the wind locks for excessive movement before engaging, and for binding, jamming, or improper fit.

1.10.10 Box Girders: Do not overlook inspection of the inside of boxed or closed girders.

1.11 INSPECTION OF FLOOR SYSTEMS. (See Figure 1-21)

1.11.1 Steel: Inspect steel floor beams and stringers as described in section 1.10.

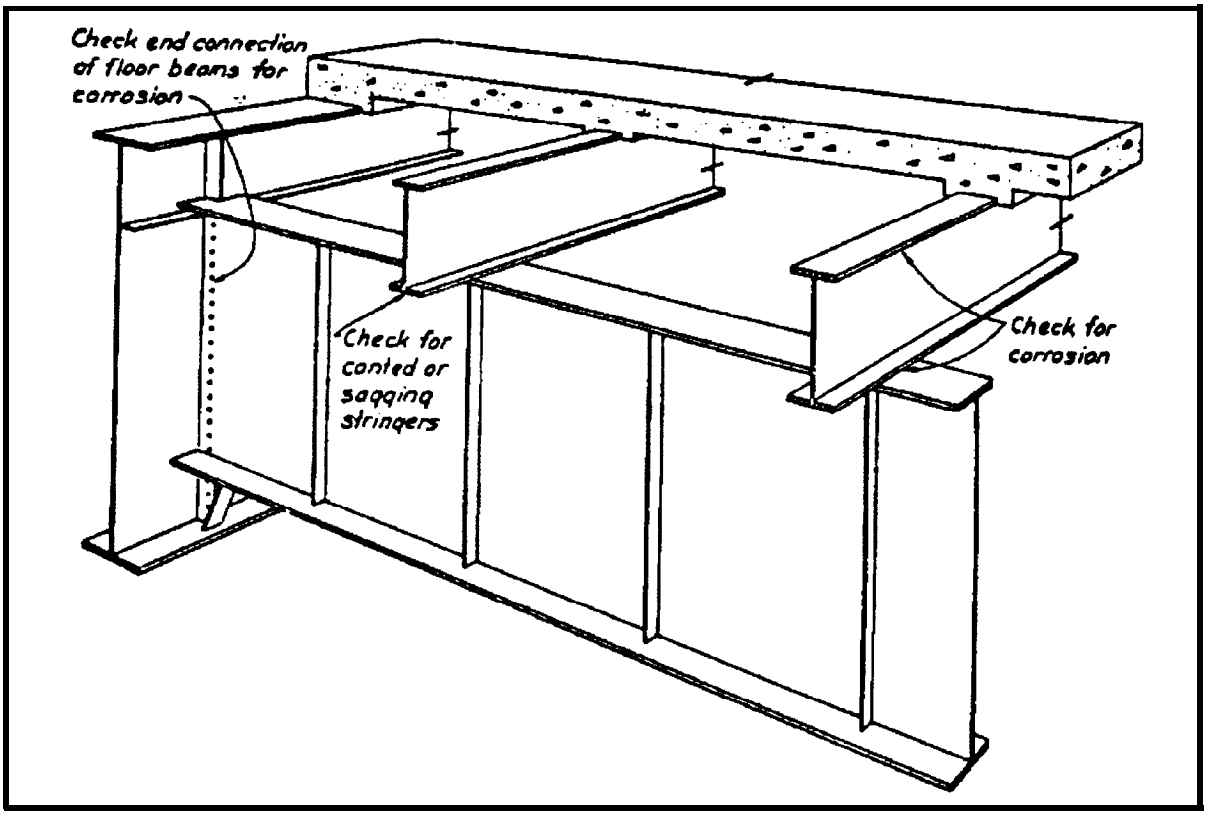

Figure 1-21
Steel Floor Beam Checklist

- Check for sagging or canted stringers.
- Check all stringer connections for loose fasteners and clip angles. Where stringers are seated on clip angles check for cracks in the floor beam web.

1.11.2 Timber:

- Check for crushing and decay, especially along the top where the decking comes in contact with the stringer and at points at which the stringer bears directly upon the abutment and bent caps.
- Check for horizontal cracks and splitting, especially at the ends of stringers where they are often notched.
- Check for sagging or canted stringers.
- Check the bridging between the stringers to determine whether it is tight and functioning properly.
- Check for accumulations of dirt and debris.

1.12 INSPECTION OF TRUSSES.

1.12.1 Steel Trusses:

- Check for rust and corrosion on the lower chord of through trusses, and on members adjacent to the curb. Check between the adjacent faces of eye bar heads, pin plates, etc. for accumulations of debris along lower chord members and connections. Note any deformation caused by expanding rust on the inside surfaces of laminated or overlapping plates.
- Sight along the roadway rail or curb and along the truss chord members to detect misalignment and evidence of collision. Investigate and report any abnormal deviations since buckled, torn, or misaligned members may severely reduce the load-carrying capacity of the truss.
- Check for local buckling in compression members. Look for wrinkles or waves in the flanges, webs or cover plates.
- Check for necking down of tension members or flaking paint which could indicate over stressing of tension members.
- Check for loose connections. Cracks in the paint or displaced paint scabs around tee joints and seams of gusset plates and other riveted or bolted connections may indicate looseness or slippage in the joints. Check rivets and bolts that appear defective or are missing.
- Inspect pins for scoring and other signs of wear. Be sure that spacers, nuts, retaining caps, and keys are in place.

- Note clashing of metal with the passage of live loads.
- Check multi-section tension members to see that stresses are balanced between member components.
- Check adjustment of counter members.
- Check looped rod tension members for abnormal cracking where the loop is formed.
- Examine eyebar members for cracks in the eyes.
- Check whether spacers on pins are holding the eyebars and looped rods in their proper position.
- Check the physical condition of threaded members such as truss rods at turn buckles

1.12.2 Timber Trusses:

- Check for weathering, checking, splitting, and decay. Check for decay at joints, splices, caps, and around bolt holes. Check joints where there are contact surfaces, daps, or holes where water can enter. Decay is also common on the bridge seat and at end panel joints.
- Check for crushing at the end of compression chord and diagonal members.
- Note whether bolts and connections are tight.
- Check for dirt or debris accumulation on the bridge seat.
- Check the roof and sides of covered bridges for adequacy of protection afforded the structural members from the weather.
- Check the alignment of the truss. Sagging of the truss may be due to the partial failure of joints or improper adjustment of steel vertical rods.
- Note fire hazards, such as brush or drift accumulating under the bridge, storage of combustible material under the bridge, parking of vehicles under the bridge, or signs of fires built by vagrants, children, or workmen under the bridge.

1.13 INSPECTION OF DIAPHRAGMS AND CROSS FRAMES.

1.13.1 Steel: Check for loose or broken connections between the web of the beam or girder and the diaphragm (Figure l-22). Check for rust around rivets and bolts, and where end diaphragms come in contact with the bridge floor. Look for buckled or twisted cross frames, this may be an indication of bracing overstress.

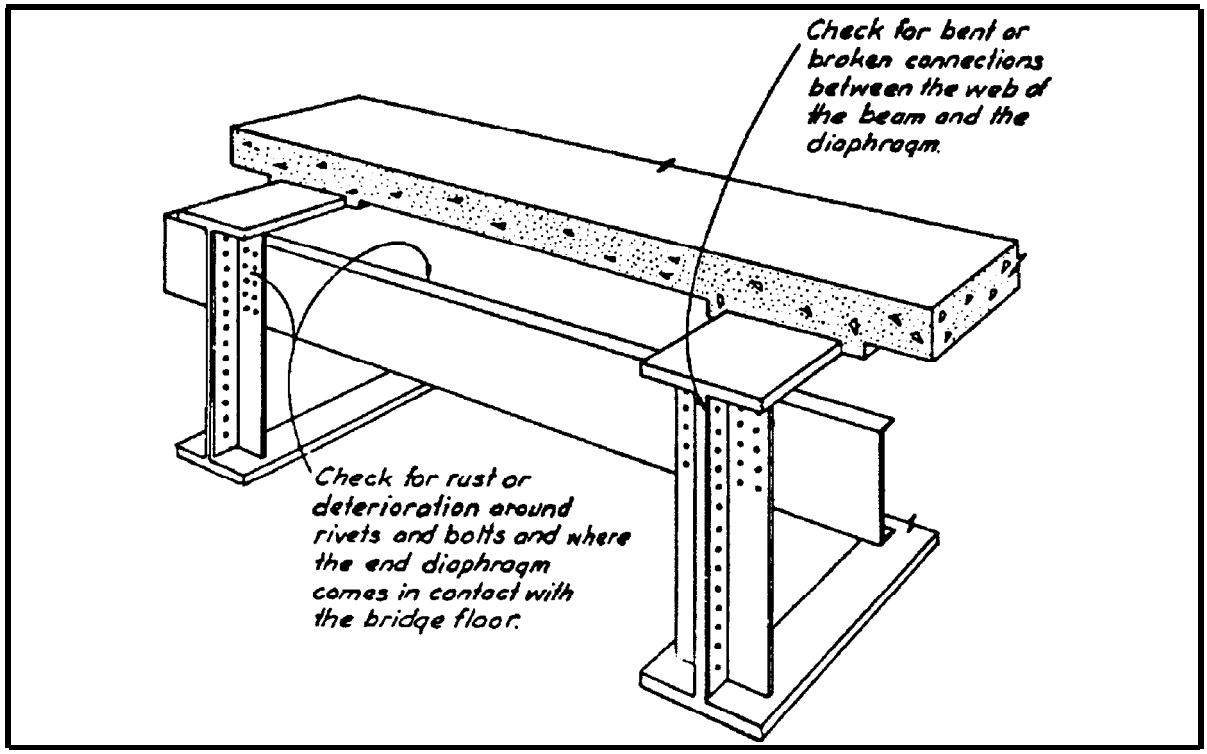

Figure l-22
Diaphragm Checklist

1.13.2 Timber: Check for cracking or splitting, especially in end diaphragms that are supporting the floor. Check for decay along the top of the diaphragms where they come in contact with the floor.

1.13.3 Concrete: Check for cracks, spalls, and for other forms of deterioration.

1.14 INSPECTION OF LATERAL BRACING PORTALS AND SWAY FRAMES.

1.14.1 Corrosion: Check members for rust on horizontal surfaces such as lateral gusset plates at pockets without drains or with clogged drains, and around bolts and rivets.

1.14.2 Loose Connections: Look for loose or broken connections. Where lateral bracing is welded to girder flanges, inspect the welds and flanges for cracking.

1.14.3 Bracing Adjustment: Check for proper adjustment of all upper and lower bracing members.

1.14.4 Collision Damage: Check for bent or twisted members for collision damage. Bends or kinks could significantly reduce member effectiveness. Portals and sway braces restrict clearances and are vulnerable to high load damage.

1.14.5 Vibration: Observe transverse vibration or movement of the structure under traffic to determine adequacy of lateral and sway bracing.

1.15 INSPECTION OF METAL BEARINGS. Bearings should be carefully examined after unusual occurrences such as heavy traffic damage, earthquakes or batterings from debris in flood periods.

1.15.1 Corrosion: Check that rockers, pins, and rollers are free of corrosion and debris. Excessive corrosion may cause the bearing to "freeze" and become incapable of movement which prevents relief from temperature expansion and contraction forces.

1.15.2 Sliding Bearings: Check slotted hole or sliding bearings to ensure that the anchor bolts are not frozen to the bearing. Check anchor bolts for loose or missing nuts.

1.15.3 Alignment: Check that bearings are properly aligned, in complete contact across the bearings surface, and that the bearing surfaces are clean.

1.15.4 Lubrication: Check bearings that require lubricants for proper lubrication.

1.15.5 Electrolytic Corrosion: Look for electrolytic corrosion where bronze sliding plates are used. This condition is common on bridges that are located in salt air environments.

1.15.6 Loose Bearings: Listen for bearing rattles under live load conditions that usually indicate loose bearings. Determine the cause of this condition.

1.15.7 Rocker Tilt: Measure the rocker tilt to the nearest 1/8 inch offset from the reference line as shown in Figure l-23. The appropriate amount of rocker tilt depends upon the temperature at the time of observation. Most rockers are set to be vertical at 68°F for steel bridges. Record the temperature at the time of inspection.

1.15.8 Horizontal Travel: Measure the horizontal travel of the sliding bearings to the nearest 1/8 inch from the reference point. The two punch holes are aligned vertically at the standard of temperature used (usually 68°F). Record the temperature at the time of inspection.

1.15.9 Skewed Bridges: Check bearings and lateral shear keys on skewed bridges to see if either are binding or if they have been damaged by the creep effect of the bridge.

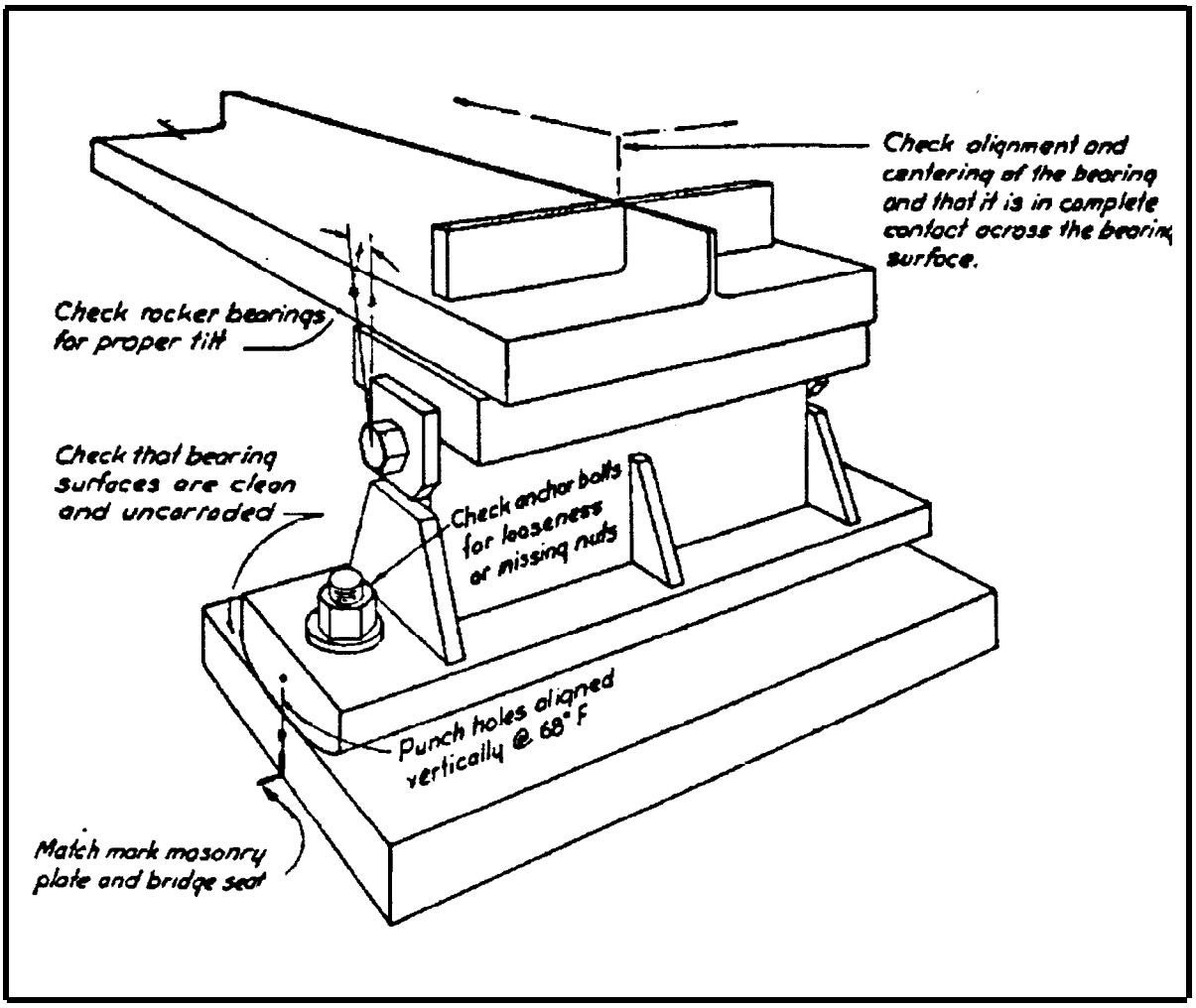

Figure 1-23
Metal Bearing Checklist

1.15.10 Hangers: Check cantilever girder hanger connections and pin bearing connections for corrosion and improper alignment.

1.16 INSPECTION OF ELASTOMERIC BEARINGS.

1.16.1 Slitting and Tearing: Check for slitting or tearing, either vertically or horizontally (Figure l-24).

1.16.2 Bulging: Check for bulging caused by excessive compression. Look for variable thickness other than that which is due to the normal rotation of the bearing.

1.16.3 Condition: Note the physical condition of the bearing pads and any abnormal flattening which may indicate overloading or excessive unevenness of loading.

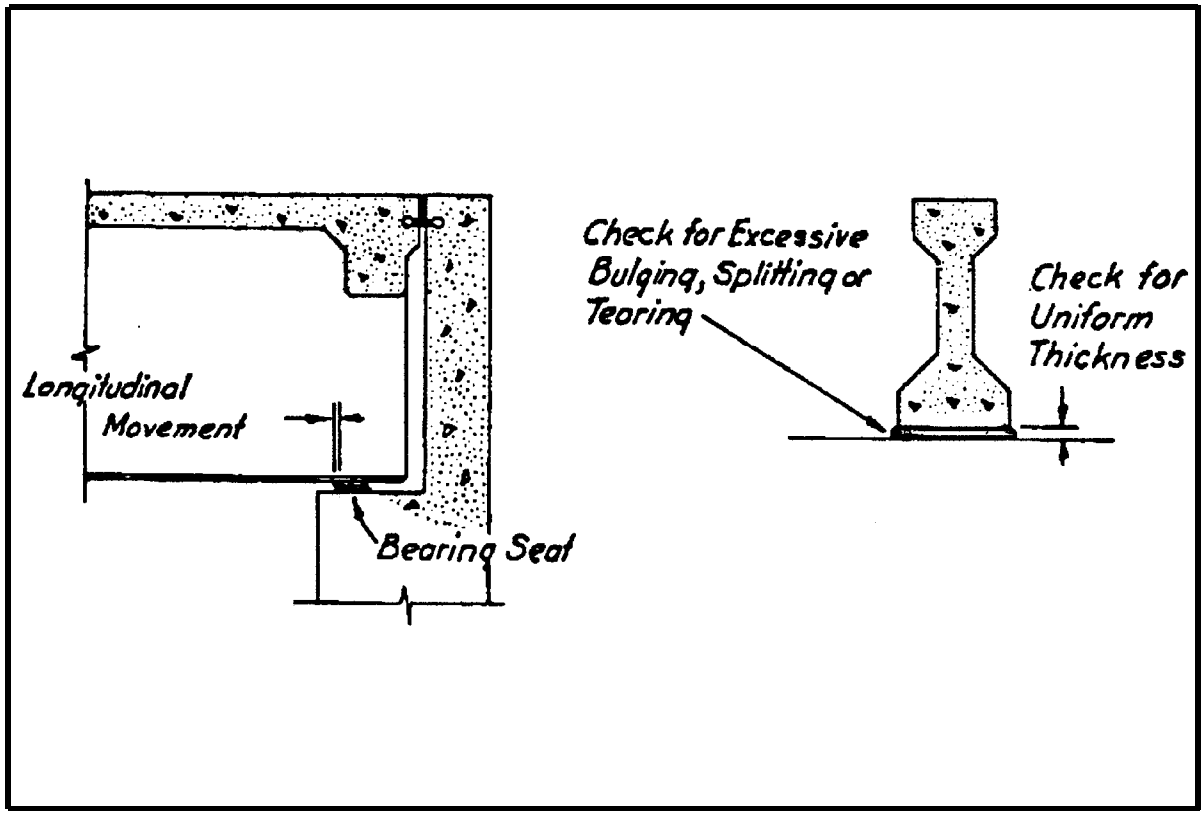

Figure l-24
Elastomeric Pad Checklist

1.17 INSPECTION OF DECK.

1.17.1 Concrete Decks:

- Check for cracking, scaling, and spalling of the concrete and record the extent of the deterioration. Determine the extent of spalling by tapping lightly with a hammer in the vicinity of the spall. A hollow sound indicates a separation or fracture plane in the concrete beneath the surface. The hollow area should be marked, measured, and recorded. Expansion joints and construction joints should be examined most thoroughly for spalling. Spalling may be caused by poor construction methods, defective materials, inadequate maintenance or drainage, and deck and/or foundation movement.
- Note the type, size, and location of cracks in the deck.
- Determine whether the concrete surface is worn or polished. When softer limestone aggregates are used in the concrete, fine aggregates and paste will be worn away, exposing the surface of the coarse aggregates to the polishing action of rubber tires. The resulting slippery surface becomes increasingly hazardous when the surface of the limestone is wet.

- Examine the wearing surface covering the concrete deck for reflection cracking and for poor adherence to the concrete. Deteriorated concrete beneath the wearing surface will often be reflected through the surface in the form of map cracking. Poor adherence leads to development of potholes. If deterioration is suspected, remove a small section of the wearing surface in order to check the condition of the concrete deck.
- Inspect the underside of the deck for cracks and water leakage. The passage of water through the deck usually causes some leaching of the concrete which forms grayish-white deposits of calcium hydroxide in the area of the leak. Extensive water leakage may indicate segregated or porous concrete, or a general deterioration of the deck.
- Areas of wet concrete are additional indications of defective concrete. Remove several panels of stay-in-place forms, if cracking is suspected, to permit examination of the underside of the deck. Rusty forms, water dripping from pinholes, or the separation of portions of the forms from the deck are reliable indications of deck cracking.
- Note any stains on the concrete which would indicate that the reinforcing steel is rusting. Note whether any of the reinforcing steel is exposed.

1.17.2 Timber Decks: Inspect for fungus decay (particularly at contact points with stringers), insect damage and weathering. Check for loose fasteners and loose, broken or worn planks. Check asphalt overlays for the presence of potholes and cracking as a result of weak areas in the deck. Observe deck under passing traffic for looseness or excessive deflection. Observe the traction of vehicles using the bridge for signs of slipperiness.

1.17.3 Steel Decks: Check for corrosion and cracked welds. Check to determine if the deck is securely fastened. Note any broken welds or clips. Determine if there is any loss of section due to rust or wear. Note whether decks are slippery when wet.

1.17.4 Open-Grating Decks: Examine the grating, support brackets and stringers for cracking of welds. Note whether decks are slippery when wet. Small steel studs may be welded to the grating in order to improve traction.

1.18 INSPECTION OF EXPANSION JOINTS.

1.18.1 Expansion Joints: Check all expansion joints for freedom of movement, clearance, and vertical alignment (Figure l-25). There should be sufficient room for expansion, but the joint should not be unduly open. Proper opening size depends on the season, the type of joint seals, the temperature range, and the length of the slab whose expansion the joint must accommodate. Normal temperature is usually assumed to be 65° to 70°F. Table A lists typical openings for various types of expansion joints. The expansion length in Table A is the portion of deck or structure whose expansion must be accommodated by the joints. This distance may extend from the end of the bridge to the nearest fixed bearing, or it may be the sum of the distance on both sides of the joint. Multiplying the expansion length by the differential between the existing temperature and 68°F; and this product by 0.0000065 will give the approximate change in joint openings from the values listed above. Construction plans will often indicate the correct setting of expansion joints.

TABLE A
Expansion Joint Data

Joints	Expansion Lengths	Joint Openings at 68°F
Steel finger dams	200 feet or more	3 inches min.
Steel expansion plates	200 feet maximum	2 inches
Compression seals	135 feet maximum	1 5/8 inches
Poured sealants and joint fillers	120 feet maximum	1 1/2 inches

1.18.2 Seals: Check seals for water tightness and general conditions. Check for seal or sealant pulling away from the edges of the joints, abrasion, shriveling, or other physical deterioration and stains and other signs of leakage underneath the deck. Leaking seals permit water and brine to flow onto the bridge seat and pier cap causing corrosion of bearings, disintegration of concrete, and staining. Joints not properly sealed should be cleaned and resealed.

1.18.3 Miscellaneous: Check for stones and debris lodged in expansion joints. Stones can create localized stresses causing cracking and spalling of the deck. Large amounts of debris cause jamming, rendering the joints ineffective. Verify that surfacing material has not jammed finger joints on bridges that have been resurfaced several times. Examine steel finger type joints and sliding plate joints for evidence of loose anchorages, cracking or breaking of welds, or other defective details. Carefully check the underside of expansion joints, regardless of accessibility, to detect any existing

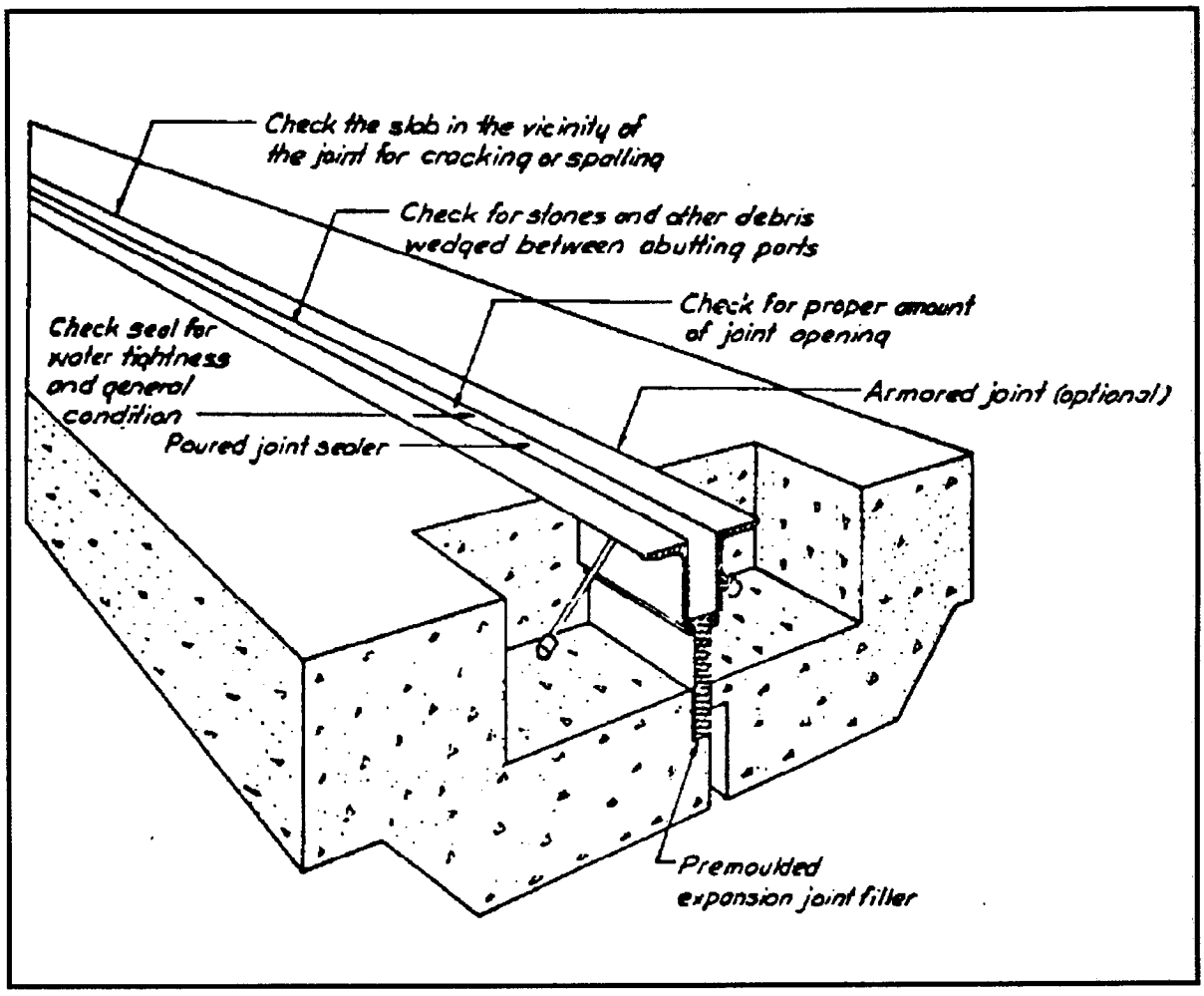

Figure 1-25
Expansion Joint Checklist

or potential problems. Sound the concrete deck adjacent to all expansion devices for voids or laminations.

1.19 INSPECTION OF RAILINGS, SIDEWALKS, AND CURBS.

1.19.1 Railings:

- Inspect all railings for collision and deterioration damage. Examine joints to see that they are open and functioning properly. Check to see that railings are of adequate height, secure, and relatively free of slivers or any projections which would be hazardous to pedestrians. Note whether guide railings on the approaches extend beyond the end of the bridge railing or parapet end and are anchored to the inside face. This feature reduces the severity of vehicle collision. If parapet ends are unprotected, and no approach rail exists, a flared, tapered approach railing should be installed.

On two way bridges, this type of railing should be installed at both ends of the existing railings or parapets. Check guide railings for traffic damage and alignment.

- Check concrete railings for cracking, disintegration, and corrosion of rebars.
- Check steel and aluminum railings for loose connections and corrosion. Check the condition of the connections of the posts to the decks, including the condition of the anchor bolts and the deck area around them. Check for rust stains on the concrete around the perimeter of steel rail posts which are set in pockets. Remove grout from around the posts and determine severity of corrosion if rust stains indicate that such action is warranted.
- Check timber railings for decay, loose connections, and for missing or damaged rails.
- Check vertical and horizontal alignment of all handrails for indications of settlement or bearing deficiencies of the structure.

1.19.2 Sidewalks:

- Check drainage for adequate carry-off. Check surface for roughness and pedestrian hazards. Check structural integrity of sidewalk brackets.
- Inspect concrete sidewalks and parapets in the same manner as the bridge decks for cracks, spalls and other deterioration. Check concrete sidewalk joints, especially at the abutments, for signs of differential settlement.
- Check steel sidewalks for corrosion and to see that all connections are secure.
- Check timber sidewalks for deterioration. Determine whether the floor planks are sound and adequately supported. Check for loose or missing planks, large cracks, warping, slipperiness, protruding nails, or other hazardous conditions.

1.19.3 Curbs:

- Report curbs or safety walks which project into the roadway, or a narrow shoulder of the roadway. Note loss of curb height resulting from the build-up of the deck surface.
- Check concrete curbs for cracks, spall, and other deterioration.
- Check timber curbs and wheel guards for splitting, warping, decay, and loose anchor bolts. Note condition of the painting of timber wheel guards where paint is used to improve visibility.

1.20 INSPECTION OF APPROACHES.

1.20.1 Back Wall Joint: Inspect the joint as indicated in section 1.11.5. Additionally, check vertical displacement by laying a straight edge across the joint, noting any differences in elevation across the joint not caused by the grade. If the deck is lower than the approach, or if the straight edge indicates a rotation, then foundation settlement or movement may have occurred, and other indications of such action should be checked.

1.20.2 Other Transverse Joints: Examine for closing or clogging. Note the relative movements (if any) of the joints, any clogging with stones or other debris, and any failure, deterioration, leakage, or slippage of the joint seal.

1.20.3 Approach Slabs: Check for cracking or tipping, indicating poor backfill compaction (although, on a skewed bridge, it would not be unusual for an acute corner to crack).

1.20.4 Shoulders and Drainage: Check whether the shoulders are maintained at the same height as the pavement. There should be adequate provisions to carry off drainage in catch basins or ditches, especially if water is allowed to flow off the bridge deck.

1.20.5 Approach Slopes: Check for adequacy and report any condition which impairs their design function.

1.20.6 Pavement Approaches: Report potholes, severe cracks, surface unevenness, or other surface defects that make the approach unusually rough or indicate approach settlement.

1.21 INSPECTION OF BRIDGE DRAINAGE.

1.21.1 Clogging or Inadequate Drainage Openings: Check the deck and the deck inlets for signs of clogging or inadequate drainage openings. Look for debris on, or around the inlet, scaling of concrete around inlet, and water stains.

1.21.2 Drain Outlets: Check to see that deck drain outlets (scuppers) do not discharge water where it may be detrimental to other members of the structure, cause fill and bank erosion, or spill onto a roadway below.

1.21.3 Damaged Pipes: Look for pipes damaged by freezing, corrosion, or collision. Often detected by cracks, holes or stains.

1.21.4 Clogged Pipes: If possible, open the cleanout at bottom of pipes to see whether pipes are open all the way through.

1.21.5 Sand and Soil Accumulations: Check for layers of sand or soil on the bridge deck and note their locations.

1.22 INSPECTION OF DOLPHINS AND FENDERS. Check dolphins or fenders for cracks, buckled or broken members, and collision damage. Note loose or broken cables which would tend to destroy the effectiveness of the cluster. Note whether they should be rewrapped. Note missing walers, blocks, and bolts. Piling and whalers require particular attention since these are areas most likely to be damaged by impact. Note whether protective treatments need patching or replacing. This includes breaks in the surface of treated timbers, cracks in protective concrete layers, rust holes or tears in metal shields, and bare areas where epoxy or coal tar preservatives have been applied externally. Note the condition of the catwalks for fender systems.

1.22.1 Steel: Observe the "splash zone" for severe rusting and pitting. The splash zone is the area from high tide to 2 feet above high tide. Where there are no tides, it is the area from the mean water level to 2 feet above it.

1.22.2 Concrete: Look for spalling and cracking of concrete, and rusting of reinforcing steel. Be alert for hour-glass shaping of piles at the water line.

1.22.3 Timber: Observe the upper portions lying between the high water and mud line for marine borers and decay. Check the fender pieces exposed to collision forces for signs of wear.

1.23 INSPECTION OF WATERWAYS.

1.23.1 Insufficient Freeboard: Check that high water level is below the bottom of the superstructure. Determine heights of past major floods from stream gauging records, or from observations made during or immediately following high water. In the absence of gauging records, check for high water marks or ice scars on trees, water marks on painted structures, debris wedged beneath the deck or on the seats, or information from established local residents. In addition to the signs mentioned previously, lateral displacement of old superstructures is an indication of insufficient freeboard.

1.23.2 Debris and Obstructions: Check for debris deposits along the banks upstream and around the bridge which could clog the waterway during a flood. Debris or vegetation in the waterways, both upstream and downstream, may reduce the width of the waterway, contribute to scour, and even become a fire hazard.

1.23.3 Scour:

- Run a channel profile, at Ml-foot intervals, for several hundred feet upstream and downstream, in stream beds susceptible to scouring. Compare with past records to determine scouring tendencies, shifts in the channel and degradation. Soundings for scouring should be taken in a radial pattern around large river piers. Sand and gravel bars formed in the channel may increase stream velocity, leading to scour near piers and abutments.
- Examine the condition and adequacy of existing bank and shore protection. Check for bank or levee erosion caused by improper location or skew of piers or abutments. Note whether channel changes are impairing the effectiveness of protection. Determine whether it is advisable to add more channel protection or to revise the existing protection.

1.23.4 High Backwater: Check for locations where high fills and inadequate or debris-jammed waterways may create a very high backwater. Washout of waterway debris dams during rainfall could result into a disastrous failure.

1.23.5 Wave Action and Ice Jams: Observe the effect of wave action and the surrounding area for existing and potential problems, such as ice jams on the bridge and its approaches.

1.24 INSPECTION OF BOX CULVERTS.

1.24.1 Culvert Sag: Check for sag of the culvert floor. In times of light flow, this may be noted by location of sediment. Where there are several feet of water in the box, a profile of the crown may be taken.

1.24.2 Roadway Sag: Check for sag in the profile of the roadway overhead.

1.24.3 Expansion Joints: Check for differential settlement at the expansion joints. Check for widely open expansion joints. Water may be seeping through joints from soil outside.

1.24.4 Wing Walls: Check for canted wing walls. This condition may be due to settlement, slides, or scour.

1.24.5 Slide Failure: Check for slide failures in the fill around the box. Such slides are likely to affect the box as well.

1.24.6 Slab Deterioration: Check for cracks and spall in the top slab. Iongitudinal cracks indicate either shear or flexure problems; transverse cracks indicate dif-

ferential settlement. Cracks in the sides may be from settlement or from extremely high earth pressures. Note the size, length, and location of the crack. Look for exposed or rusty rebars.

1.24.7 Undermining: Where there is no bottom slab, look for undermining of side footings. Check for undermining at the ends of the box and under the wings. Check for bottom slab cracks, top slab for hollow sound where undermining is suspected.

1.24.8 Debris: Examine the inside of the box for debris. This may indicate the need for a debris rack. Check the inlet end of the culvert for debris. Note whether vegetation is obstructing the ends of the culvert.

1.24.9 Abrasion: If the culvert floor is visible, check it for abrasion and wear.

1.25 INSPECTION OF PAINT Examine all paint carefully for cracking or chipping, scaling, rust pimples, and chalking. Look for evidence of "alligatoring." If the paint film has disintegrated, note whether the prime coat or the surface of the metal is exposed. Note the extent and severity of the paint deterioration. If extensive "spot" painting is required, the entire structure probably needs to be repainted; otherwise "spot" painting will likely be sufficient.

1.25.1 Failure Areas: Especially look for paint failure on upper chord horizontal surfaces, surfaces most exposed to sunlight or moisture, areas around rivets and bolts, ends of beams, seams of built-up members, unwelded ends of stiffeners, and other areas that are difficult to paint or may retain moisture.

1.26 INSPECTION OF SIGNING.

1.26.1 Types of Sign: When inspecting for signing, note not only the signs that are posted, but whether additional signs are needed because of changed bridge or roadway conditions. The types of warning and regulatory signs that are normally required are:

1.26.1.1 Weight Limit: Important inspection item, especially for older bridges. Pre 1940 constructed bridges are susceptible to capacity limitation problems.

1.26.1.2 Vertical Clearance: Where no limiting vertical clearances are posted for through-truss bridges, railroad underpasses, or old grade separations, measure the clearances to determine whether they meet the established legal minimum standard. Any clearance that is less than 1 foot greater than the legal height and load limit should be posted with a "Low Clearance" sign.

1.26.1.3 Lateral Clearance: "Narrow Bridge" signs and striped paddleboards should be used when the bridge width is less than that of the approach roadway. If the superstructure or parapet end extends above the curb, it should be striped and a reflectorized hazard marker should be attached.

1.26.1.4 Narrow Underpasses: Where the roadway narrows at an underpass or where there is a pier in the middle of the roadway, striped hazard markings should be placed on the abutment walls and on pier edges. Reflective hazard markers should also be placed on the piers and abutments, and the approaching pavement should be appropriately marked to warn the approaching traffic of the hazard.

1.26.1.5 Speed and Traffic Markers: These types of signs should be checked to ascertain whether they are appropriate. Speed restrictions should be carefully noted to determine whether such restrictions are consistent with bridge and traffic conditions. Additional traffic markers may be required to facilitate the safe and continuous flow of traffic.

1.26.1.6 Single Traffic Bridges and Underpasses: If line of site is not adequate, signals are required to control traffic flow. Check condition clarity and timing of signal system. Motorist warning signs should be posted.

1.26.1.7 Movable Bridges: Signs warning of draw spans and submarine cables should be posted. Interconnected traffic signals and drawbridge gates should also be provided.

1.26.2 Location: Warning signs should be located sufficiently in advance of the structure to permit the driver to react. The weight limit sign should be located just ahead of the bridge. Lateral clearance of the sign should be determined by the requirements of the highway type. Preferably signs should be located behind a barrier guiderail or affixed to a breakaway standard.

1.26.3 Condition: Check signs for reflectorization, legibility, vandalism, and damaged supports. Observe whether signs are obscured by vegetation. Consult the Manual on Uniform Traffic Control Devices (MUTCD) for specific information with regard to signing. If relocation of sign(s) is necessary, include such remarks in the inspection report.

1.26.4 Minimum Sizes: Check for minimum size. Most warning signs are diamond-shaped and measure at least 30 inches x 30 inches. "Low Clearance" signs are 36 inches x 36 inches. The "Weight Limit" signs are rectangular with minimum dimensions of 18 inches x 24 inches.

1.27 INSPECTION OF UTILITIES.

1.27.1 Deterioration: Check pipes, ducts, etc., for leaks, breaks, cracks, and deteriorating coverings. Note leaky water or sewer pipes located above the decks or on top of beams. Check for wear or deteriorated shielding and insulation on power cables. Check the encasement of pipes carrying fluids under pressure for damage. Note leaky drains or vents. Check for the presence of shut-off valves on pipe lines carrying hazardous pressurized fluids, unless the fluid is controlled by automatic devices.

1.27.2 Supports: Check supports for signs of corrosion, need of painting, damage, loose connections, and general lack of rigidity. If utility mounts rattle during passage of traffic, especially on steel bridges, note need for padding.

1.27.3 Leaks at Abutments: Check the annular space between pipe and sleeve, or between the pipe and the blocked up area for leaks where utilities pass through abutments.

1.27.4 Dangerous Situations: Check whether mutually hazardous transmittants, such as volatile fuels and electricity, are sufficiently isolated from each other. If such utilities are side-by-side or in the same bay, report this condition for either auxiliary encasement or future relocation.

1.27.5 Clearance: Check utilities that are located beneath the bridge for adequate roadway clearances. Determine whether utilities obstruct the waterway area or may hinder drift removal during periods of high water. Check whether utilities may possibly be struck and damaged by traffic or by ice and debris carried by high water.

1.27.6 Adverse Effects: Check for any adverse effect utilities may have on the bridge, e.g., interference with bridge maintenance operations or an impairing of structural integrity. Check to determine if vibration or expansion movements are causing damage to support members or to the bridge structure and foundations. Note adverse aesthetic effects utilities may have on the bridge.

ANNUAL BRIDGE INSPECTION GUIDE SPECIFICATION
SECTION 1
BRIDGE INSPECTION - GENERAL

1.0 **SCOPE:** This specification covers the general requirements for bridge inspection. Specific requirements are covered by the applicable detailed specifications. All physical features of the bridge, slopes and retaining structures having an effect on the bridge capacity shall be inspected.

2.0 **APPLICABLE PUBLICATIONS:** The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification and supplementary detailed sections to the extent indicated by the references thereto:

2.1 American Association of State Highway and Transportation Officials (AASHTO):

Manual for Maintenance Inspection of Bridges (1978)

Standard Specifications for Highway Bridges (1973, and 1974 and 1975 Interim Specifications)

2.2 American Railway Engineering Association (AREA):

Manual for Railway Engineering

2.3 National Fire Protection Association (NFPA):

70-1975 National Electrical Code

2.4 US Department of Transportation, Federal Highway Administration, Bureau of Public Roads (DOT):

1B-40 Manual on Uniform Traffic Control Devices (MUTCD) 1978

1B-70 Bridge Inspector's Training Manual (1978)

3.0 **QUALIFICATIONS OF PERSONNEL:** Each inspection shall be made by a structural engineering technician under the direct supervision of a qualified structural engineer in the state where the inspection is to be performed.

4.0 **INFORMATION FURNISHED BY THE GOVERNMENT:**

4.1 General Information: The Government will make available to the Contractor all available information pertaining to age of the bridge, materials, previously reported bridge damage, repairs, and design criteria specific to special usage of the bridge.

4.2 Drawings of Bridge: The Government will make available to the Contractor as-built or record drawings and original design construction specifications of the bridge, if available.

4.3 Previous Inspection Reports: The Government will make available to the Contractor copies of all previous inspection reports, if reports are available.

4.4 Maps: The Government will make available to the Contractor map(s) indicating the bridge location.

5.0 **TOOLS AND EQUIPMENT FOR INSPECTION:** The Contractor shall furnish all tools and equipment required for the inspection. The Contractor shall also provide any electrical power and special equipment necessary to facilitate inspection.

6.0 **SAFETY REQUIREMENTS:**

6.1 General: The Contractor shall be responsible for the safety of personnel and the public during the inspection. Items for public safety shall comply with applicable provisions of DOT Manual 1B-40, MUTCD.

6.2 Safety of Inspector: Safety equipment and procedures shall comply with, but not be limited to, Section 2 of Chapter 2 of DOT Manual 1B-70, Bridge Inspector's Training Manual.

7.0 **COORDINATION:** The Contractor shall provide an inspection schedule to the Contracting Officer for approval. The inspection schedule shall be approved by the Contracting Officer prior to beginning the inspection. Changes in the schedule shall be approved by the Contracting Officer. Scheduling shall take into account time limitations, manpower and time requirements, weather, stream levels, and seasonal traffic loads on the structure.

8.0 **RESPONSIBILITY:** The Contractor shall be responsible for the thoroughness of the field inspection, the analysis of all findings ascertained by the inspection, and the

subsequent recommendations for correction of defects, posting for load or speed limit and other recommendations deemed necessary.

9.0 **GENERAL INSPECTION REQUIREMENTS:** The report submitted as a result of these inspections shall be made in such a manner to facilitate the preparation of a contract for maintenance and repair of the bridge.

9.1 General: All bridge structural members shall be examined to reveal misalignment or excessive settling. Inspection shall determine that the vertical bridge alignment matches that of the roadway.

9.2 Determination of Deficiencies:

9.2.1 Asphalt Concrete Wearing Surface: Inspect wearing surface for cracking, shoving, deterioration, potholes and slipperiness.

9.2.2 Trench Drains, Covers, Inlets, Outlets and Drain Pipes: Inspect for deterioration of deck near trench drain or inlet, clogging, inadequate drain openings, especially drainage systems blocked by overlays, and broken covers. Inspect outlets for discharge of water where it is detrimental to other structural members and the roadway, causes fill and bank erosion, or endangers traffic safety on or below the bridge deck. Inspect drain pipes for corrosion, deterioration, cracks from freezing and clogging.

9.2.3 Expansion Joints: All expansion joints shall be inspected for vertical alignment, freedom of movement and amount of joint opening. Inspect sealed deck joints and neoprene expansion joints for water-tightness, cracking or deterioration of sealer and sealant pulling away from edge of joint. Finger plate expansion joints and steel plate expansion joints shall be inspected for debris in joint corrosion or deterioration of joint armor, loose anchorages, cracked welds, and damaged or jammed fingers. Inspect in the vicinity of the joint for cracking or spalling of the concrete slab.

9.2.4 Railings and Fencing: Inspect railings for horizontal and vertical misalignment, collision damage, loose posts or rails, rust and rot or corrosion, and loose connections and anchor bolts. Inspect steel flex beam rails for proper lapping in direction of traffic and deterioration of protective coating. Inspect for spalling and disintegration of concrete, corrosion of rebars, slivers in rails, decay, loose connections at rails or posts, and missing or damaged rails. Inspect fencing for horizontal and vertical misalignment, collision damage, loose posts, loose connections and anchor bolts, rust and corrosion, deteriorated paint/vinyl coating and breakage of fence strands.

9.2.5 Approaches: Inspect embankment and embankment protection for erosion, drifting, inadequate slope, inadequate riprap protection, and deterioration of slopewall. Inspect pavement for roughness, difference in vertical elevation due to settlement causing

increased impact and vibration in bridge, and cracking and deterioration of sealant in cracks and joints, other than expansion joints. Inspect joints for vertical displacement, incorrect opening width, clogging, and damaged or deteriorated joint seal. Inspect access ramps for roughness, deterioration, slipperiness when wet and inadequate guiderail.

9.2.6 Stairways: Inspect for unsafe steps due to roughness or deterioration, slipperiness when wet, inadequate or unsafe handrails, horizontal and vertical misalignment, loose treads, collision damage, rust and rot or corrosion, loose connections and anchor bolts, deterioration of supporting structure, disintegration of concrete, and corrosion of reinforcing.

9.2.7 Pier Protection: Inspect dolphins, fenders, and cells for collision damage, damage due to uplift from lateral loads or ice loads, and cracked, buckled, decayed, abraided and broken members, and loose or broken cables and dolphin/fender wrappings.

9.2.8 Waterway: Adequacy of waterway shall be determined by inspecting for insufficient waterway opening, insufficient freeboard, debris deposits along upstream banks, debris or vegetation in the waterway, both upstream and downstream, and silting of channel. Inspect for scour in channels and near abutments and piers resulting in undermining of footings and exposure of piles. Inspect for drift of the channel to a new alignment resulting in improper bridge location with respect to the channel. Inspect for slope protection, erosion, inadequacy and ineffectiveness.

9.2.9 Signing, Supports and Lighting: Inspect signs for deficiencies including inadequate night visibility, dirt encrustment, dulled paint, inadequate lettering, inadequate sign size, or vandalism. Refer to the MUTCD for guidelines as to criteria to be followed in evaluating sign legibility. Inspect sign supports for deficiencies including bending and twisting. Inspect all lights for noncompliance with the National Electrical Code, light and control devices not working properly, broken globes, rusted or deteriorated conduit, junction boxes or other electrical apparatus, and improper system grounding.

9.2.10 Utilities: Inspect pipelines, cables and supports for deterioration of coverings, leaks, breaks, cracks, corrosion damage, loose connections, and lack of rigidity. Determine whether location of pipeline or cable is such that it is a hazard to traffic which may use or pass under the bridge.

9.2.11 Safety Features: Inspect the bridge system for conditions which are unsafe for pedestrian traffic or conditions which are unsafe for traffic passing below an overpass. Make appropriate recommendations.

10.0 **RESTORATION OF REMOVED ITEMS:** Contractor shall restore all items temporarily removed and surfaces that were uncovered during the inspection process to a condition matching the surrounding work. All access holes shall be patched.

11.0 **REPORT:**

11.1 Cause of Deficiencies: Insofar as practicable, the Contractor shall indicate in his Inspection Report the causes of the deficiencies.

11.2 Recommendations: Recommendations concerning repairs shall be classified into two general categories: (1) Urgently needed repairs and (2) Programmed repairs; i.e., repairs that will be incorporated into preprogrammed repair and maintenance schedules. The inspector must decide whether a repair is urgent. Whenever emergency repairs are needed, recommendations may call for repairs of a temporary nature and they must later be integrated into a permanent solution. It shall be recommended that repairs be made on a permanent basis, if such repairs can be completed as quickly and as efficiently as any available temporary means. Contractor should describe fully the type of repairs that are needed, the method of repair to be used, the scope of work to be done, an estimated cost of the materials and labor that will be required to complete the proposed repair of each item.

11.3 Photographs: Submit one set of applicable color photographs illustrating different or unusual deficiencies with the original report. Xerox copies of photographs are required with additional copies of the report.

11.4 Completed Checklist: A copy of the following completed Bridge Inspection Checklist for each bridge shall be included with the report.

11.5 Danger of Collapse: The Contracting Officer shall be notified immediately by telephone and in writing, of the condition of the bridge is such that use will be dangerous to persons or property.

Bridge Inspection Checklist

NOTE: Circle yes or no for the answer, provide N/A for items not applicable. Sketches may be required to identify the locations of problem areas.

Installation:
Location:
Bridge No.:
Bridge Classification:
Date:

Observed Deficiencies and Recommendations:

A. SUBSTRUCTURE:

1. Abutment (concrete, steel and timber or combination of materials)

a. Timber Abutment

(1) Any sign of settlement or movement? Yes/No

(2) Any steel rods rusting? Yes/No

(3) Any End Dam, wingpost, post and cap decaying? Yes/No

(4) Any block (bearing and anchor) deteriorating? Yes/No

(5) Any sill and footing decaying? Yes/No

(6) Any loose timber? Yes/No

(7) Any pile (wing and bearing) decaying or breaking? Yes/No

(8) Any signs of protective coating deterioration? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

b. Steel Pile Abutment

(1) Any sign of settlement or movement? Yes/No

(2) Any End Dam, pile and cap rusting? Yes/No

(3) Any steel member section lost? Yes/No

(4) Any bolts missing, loose or rusting? Yes/No

(5) Any signs of protective coating deterioration? Yes/No

c. Concrete Abutment, Wing Walls, Retaining Wall

(1) Any sign of settlement or movement? Yes/No

(2) Are weep holes clear and functioning? Yes/No

(3) Any bearing seats cracking or spalling? Yes/No

(4) Any concrete areas deteriorating? Yes/No

(5) Any reinforced steel exposed? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

2. Piers and Bents: Timber, steel and concrete or combination of materials

a. Timber: Trestle Bent, Trestle, Pile Pier, Pile Bent, Crib Pier

(1) Any sign of settlement or movement? Yes/No

(2) Any cap, bracing, scabbing or corbels decaying? Yes/No

(3) Any posts or piles missing? Yes/No

(4) Any posts or piles decaying? Yes/No

(5) Are piers clear of debris? Yes/No

(6) Any sill or footing section lost? Yes/No

(7) Any erosion around piers? Yes/No

(8) Any wire-rope cross bracing rusting? Yes/No

(9) Any bolts missing or loose at connecting areas? Yes/No

(10) Any splitting or crushing of the timber when:

(a) The cap bears directly upon the piles? Yes/No

(b) Beam bears directly upon the cap? Yes/No

(11) Any signs of excessive deflection of members? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

(12) Any signs of protective coating deterioration? Yes/No

b. Steel: Frame Tower, Pile Bent, Pile Pier

(1) Any sign of settlement or movement Yes/No

(2) Any steel members or bearing rusting? Yes/No

(3) Any debris around the pile? Yes/No

(4) Any steel cap rotated due to eccentric connection? Yes/No

(5) Any braces with broken connections or loose rivets or bolts? Yes/No

(6) Any member damage from collision? Yes/No

(7) Any need for painting or coating? Yes/No

c. Concrete

(1) Any sign of settlement or movement? Yes/No

2) Any concrete deteriorating or spalling? Yes/No

(3) Any pier columns and pier cap cracking? Yes/No

(4) Any bearing seats cracking or spalling? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

(5) Any reinforced steel exposed? Yes/No

(6) Any debris around piers? Yes/No

(7) Any footing section lost? Yes/No

(8) Any erosion around piers? Yes/No

B. SUPERSTRUCTURE:

1. Concrete (Girder, Beams, Frames and Slab)

a. Are any areas subject to spalling (give special attention to points of bearing)? Yes/No

b. Any signs of diagonal cracking, especially near the supports? Yes/No

c. Any signs of vertical crack or disintegration of the concrete, especially in the area of the tension steel? Yes/No

d. Any sign of excessive vibration or deflection? Yes/No

e. Any corrosion or exposure of reinforcing steel? Yes/No

f. Any corrosion. misalignment, frozen or loose at metal bearing for concrete beams? Yes/No

g. Any tearing, splitting or bulging at elastomeric bearing pads? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

2. Timber Trusses, Beams, Stringers and Bridging

a. Any signs of broken, deteriorated or loose shear connector? Yes/No

b. Any signs of failure, bowing or joint separation of individual member of trusses? Yes/No

c. Any signs of loose, broken, deteriorated or worn planks on the timber deck? Yes/No

d. Any missing or improper functionings of bridging? Yes/No

3. Steel (Girders, Stringers, Floor Beams, Diaphragms, Cross Frames, Portals, Sway Frames, Lateral Bracing, Truss Members, Bearing and Anchorage, Eyebars, Cables and Fittings)

a. Any signs of corrosion and deterioration along:

(1) Web or flange? Yes/No

(2) Around bolts and rivets heads? Yes/No

(3) Under deck joints? Yes/No

(4) Any other points which may be exposed to roadway drainage? Yes/No

(5) Eyebars, cables and fittings? Yes/No

b. Any signs of misalignment or distortion due to overstress, collision or fire? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

c. Any wrinkles, waves, cracks, or damage in the web and flange of steel beam, particularly near points of bearing? Yes/No

d. Any sign of unusual vibration or excessive deflection occurring during the passages of heavy loads? Yes/No

e. Any frozen or loose bearings? Yes/No

f. Any splitting, tearing or bulging in elastomeric bearing pads? Yes/No

g. Any need for painting or protective coating? Yes/No

C. APPURTENANCES (Decks, Curbs and Sidewalks)

1. Concrete

a. Any signs of cracking, scaling and spalling on the:

(1) Deck and/or walk surface? Yes/No

(2) Deck underside? Yes/No

(3) Wearing surface (map cracking, potholes, etc.)? Yes/No

NOTE: If deterioration is suspected, remove a small section of the wearing surface in order to check the condition of the concrete deck.

b. Any sign of exposed reinforcing steel? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

c. Is reinforcing steel rusted? Yes/No

d. Any loose or deteriorated joint sealant? Yes/No

e. Is sidewalk and deck drainage adequate? Yes/No

f. Is curb height adequate due to addition of wearing surfaces? Yes/No

2. Timber Appurtenances Decks, Curbs and Sidewalks

a. Any sign of loose, broken, deteriorated, or worn planks? Yes/No

b. Any evidence of decay, particularly at the contact point with the stringer where moisture accumulates? Yes/No

c. Any sign of excessive deflection or loose members with the passing of traffic? Yes/No

d. Is curb height adequate due to addition of wearing surface? Yes/No

e. Any sign of loose connections or missing bolts? Yes/No

3. Steel Appurtenances including but not limited to decks, gratings, curbs and sidewalks

a. Any sign of corrosion or cracked welds? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

b. Any sign of slipperiness when deck or steel sidewalk is wet? Yes/No

c. Any loose fasteners and loose connections? Yes/No

d. Any horizontal and vertical misalignment and collision damage? Yes/No

e. Any need for painting or protective coating? Yes/No

D. MASONRY BRIDGE COMPONENTS:

1. Any sign of settlement or movement? Yes/No

2. Are weep holes clear and functioning properly? Yes/No

3. Any damaged masonry by collision? Yes/No

4. Any spalling or splitting of rocks? Yes/No

5. Any mortar cracked and loose? Yes/No

6. Any plant growth, such as lichens and ivy, attacking stone surfaces by attaching themselves to the stone? Yes/No

7. Any Marine borers attacking the rock and mortar? Yes/No

Bridge No. _____

Observed Deficiencies and Recommendations:

E. MISCELLANEOUS:

1. Are bridge classification signs posted? Yes/No

2. Are approachments in satisfactory condition? Yes/No

F. UTILITY:

1. Any leaks, breaks, cracks, or deteriorating of pipes, ducts, or other utilities? Yes/No

2. Any damaged or loose supports? Yes/No

3. Any signs of wear or deteriorated shielding and insulation on power cables? Yes/No

NOTE: Under most conditions, visual observation will provide the primary inspection and will be supplemented by other methods only where the results of the visual observation indicate the desirability of more sophisticated methods.

TRIENNIAL BRIDGE INSPECTION GUIDE SPECIFICATION
SECTION 1
BRIDGE INSPECTION - GENERAL

1.0 **SCOPE:** This specification covers the general requirements for bridge inspection. Specific requirements are covered by the applicable detailed specifications. All physical features of the bridge, approaches embankments and retaining structures having an effect on the bridge capacity shall be inspected.

2.0 **APPLICABLE PUBLICATIONS:** The following publications of the issues listed below, referred to thereafter by basic designation only, form a part of this specification and supplementary detailed sections to the extent indicated by the references thereto:

2.1 American Association of State Highway and Transportation Officials (AASHTO):

Manual for Maintenance Inspection of Bridges (1978)

Standard Specifications for Highway Bridges (1973, and 1974 and 1975 Interim Specifications)

2.2 American Railway Engineering Association (AREA):

Manual for Railway Engineering

2.3 National Fire Protection Association (NFPA):

70-1975 National Electrical Code

2.4 US Department of Transportation, Federal Highway Administration, Bureau of Public Roads (DOT):

IB-40 Manual on Uniform Traffic Control Devices (MUTCD), 1978 Edition

IB-70 Bridge Inspector's Training Manual, 1978 Edition

2.5 US Army Technical Manual: TM 5-312 Military Fixed Bridges, December 1968

3.0 **QUALIFICATIONS OF INSPECTION PERSONNEL:** Bridge inspector must have the following minimum qualifications:

3.1 Inspector must be a registered professional engineer (or under the direct supervision of a registered professional engineer).

3.2 Inspector must have a minimum of 2 (two) years experience in bridge inspection assignment in a responsible capacity.

3.3 Inspector must be thoroughly familiar with design and construction features of the bridge to properly interpret what is observed and reported.

3.4 Inspector must be capable of determining the safe load carrying capacity of the structure.

3.5 Inspector must be able to recognize any structural deficiency, assess its seriousness, and take appropriate action necessary to keep the bridge in a safe condition.

3.6 Inspector must also recognize areas of the bridge where a problem is incipient so that preventive maintenance can be properly programmed.

3.7 The qualification of each person directly or indirectly involved with the inspection shall be submitted with bid documents.

4.0 **INFORMATION FURNISHED BY THE GOVERNMENT:**

4.1 General Information: The Government will make available to the Contractor all available information pertaining to age of the bridge, materials, previously reported bridge damage, repairs, and design criteria specific to special usage of the bridge.

4.2 Drawings of Bridge: The Government will make available to the Contractor as-built drawings and specifications for the bridge, if available.

4.3 Previous Inspection Reports: The Government will make available to the Contractor copies of all previous inspection reports, if reports are available.

4.4 Maps: The Government will make available to the Contractor map(s) indicating the bridge location.

5.0 **TOOLS AND EQUIPMENT FOR INSPECTION:** The Contractor shall furnish all tools, equipment and scaffolding required for the inspection. The Contractor shall also provide all electrical power and special equipment necessary to facilitate inspection.

6.0 **SAFETY REQUIREMENTS:**

6.1 General: The Contractor shall be responsible for the safety of personnel and the public during the inspection. Items for public safety shall comply with applicable provisions of DOT Manual 1B-40.

6.2 Safety of Inspectors: Safety equipment and procedures shall comply with, but not be limited to, Section 2 of Chapter 2 of DOT Manual 1B-70, Bridge Inspector's Training Manual.

7.0 **COORDINATION:** The Contractor shall provide an inspection schedule to the Contracting Officer for approval. The inspection schedule shall be approved by the Contracting Officer prior to beginning the inspection. Changes in the schedule shall be approved by the Contracting Officer. Scheduling shall take into account time limitations, manpower and time requirements, weather, stream levels, and seasonal traffic loads on the structure.

8.0 **RESPONSIBILITY:** The Contractor shall be responsible for the thoroughness of the field inspection and investigation. [The Government will provide the original design calculation for bridge(s)_____.] [No calculations are available for bridges _____.] The contractor will determine the safe load carrying capacity of all bridges. Rating of each structure for its safe load carrying capacity must be provided. All physical features of the bridge which have an effect on its structural integrity shall be examined. Note any damaged or deteriorated sections and obtain adequate data on these areas so that their effect can be properly evaluated in the analysis. The Contractor shall be responsible for the analysis of all findings ascertained by the inspection and the subsequent recommendations for correction of defects, posting for load or speed limits, and other recommendations deemed necessary.

9.0 **PLANS AND DIMENSIONS:**

9.1 Furnished drawings shall be checked for accuracy. Checking shall be to the extent necessary to determine that the drawings are representative of actual structure dimensions. Inaccurate drawings shall be noted and corrected.

9.2 The Government will provide plans of "as-built" or drawings for the following bridges _____.] [No available drawings are available for the following bridges _____.] The contractor must develop accurate plans or drawings during field investigations to permit an adequate stress analysis of the entire structure.

10.0 **GENERAL INSPECTION REQUIREMENTS:** As a minimum two photographs of each bridge, one showing a roadway view and one a side elevation view, shall be included as part of the original bridge report. Other photos necessary to show major defects, or other important features, shall also be included.

The report, submitted as a result of these inspections, shall be made in such a manner to facilitate the preparation of a contract for maintenance and repair of the bridge. The

Standard Triennial Inspection report format shown on pages B-9 thru B-15 should be used as part of the inspection report.

10.1 General: All bridge structural members shall be examined to reveal misalignment or excessive settling. Inspection shall determine that the vertical bridge aligmnent matches that of the roadway.

10.2 Determination of Deficiencies:

10.2.1 Asphalt Concrete Wearing Surface: Inspect for cracking, shoving, deterioration, pot-holes, and slippery wearing surface.

10.2.2 Trench Drains, Covers, Inlets, Outlets and Drain Pipes: Inspect for deterioration of deck near trench drain or inlet, clogging, inadequate drain openings, especially drainage systems blocked by overlays and broken covers. Inspect outlets for discharge of water where it is detrimental to other structural members of the roadway, causes erosion, or endangers traffic safety on or below the bridge deck. Inspect drain pipes for corrosion, deterioration, cracks from freezing, and clogging.

10.2.3 Expansion Joints: All expansion joints shall be inspected for vertical alignment, freedom of movement and amount of joint opening. Inspect sealed deck joints and neoprene expansion joints for water-tightness, cracking or deterioration of sealer and sealant pulling away from edge of joint. Finger plate expansion joints and steel plate expansion joints shall be inspected for debris in joint, corrosion or deterioration of joint armor, loose anchorages, cracked welds, and damaged or jammed fingers. Inspect in the vicinity of the joint for cracking or spalling of the concrete slab.

10.2.4 Railings and Fencing: Inspect railings for horizontal and vertical misalignment, collision damage, loose posts or rails, rust and rot or corrosion, and loose connections and anchor bolts. Inspect steel flex beam rails for proper lapping in direction of traffic and deterioration of protective coating. Inspect for spalling and disintegration of concrete, corrosion of rebars, slivers in rails, decay, loose connections at rails or posts, and missing or damaged rails. Inspect fencing for horizontal and vertical misalignment, collision damage, loose posts, loose connections and anchor bolts, rust and corrosion, deteriorated paint/vinyl coating, and breakage of fence strands.

10.2.5 Approaches: Inspect embankment and embankment protection for erosion, drifting, inadequate slope, inadequate riprap protection, and deterioration of slopewall. Inspect pavement for roughness, difference in vertical elevation due to settlement causing increased impact and vibration in bridge, and cracking and deterioration of sealant in cracks and joints, other than expansion joints. Inspect joints for vertical displacement, incorrect opening, width, clogging, and damaged or deteriorated joint seal. Inspect access ramps for roughness, deterioration, slipperiness when wet, and inadequate guiderail.

10.2.6 Stairways: Inspect for unsafe steps due to roughness or deterioration, slipperiness when wet, inadequate or unsafe handrails, horizontal and vertical misalignment, loose treads, collision damage, rust and rot or corrosion, loose connections and anchor bolts, deterioration of supporting structure, disintegration of concrete, and corrosion of reinforcing.

10.2.7 Pier Protection: Inspect dolphins, fenders, and cells for collision damage, damage due to uplift from lateral loads or ice loads, and cracked, buckled, decayed, abraded and broken members, and loose or broken cables and dolphin/fender wrappings.

10.2.8 Waterway: Adequacy of waterway shall be determined by inspecting for insufficient waterway opening, insufficient freeboard, debris deposits along upstream banks, debris or vegetation in the waterway, both upstream and downstream, and silting of channel. Inspect for scour in channels and near abutments and piers resulting in undermining of footings and exposure of piles. Inspect for drift of the channel to a new alignment resulting in improper bridge location with respect to the channel. Inspect for slope protection, erosion, inadequacy and ineffectiveness.

10.2.9 Signs, Supports and Lighting: Inspect signs for deficiencies including inadequate night visibility, dirt encrustment, dulled paint inadequate lettering, inadequate sign size, or vandalism. Refer to the Manual on Uniform Traffic Control Devices for guidelines as to criteria to be followed in evaluating sign legibility. Inspect sign supports for deficiencies including bending and twisting. Inspect all lights for noncompliance with the National Electrical Code, light and control devices not working properly, broken globes, rusted or deteriorated conduit, junction boxes or other electrical apparatus, and improper system grounding.

10.2.10 Utilities: Inspect pipelines, cables and supports for deterioration of coverings, leaks, breaks, cracks, corrosion damage, loose connections, and lack of rigidity. Determine whether location of pipeline or cable is such that it is a hazard to traffic which may use or pass under the bridge.

10.2.11 Safety Features: Inspect the bridge system for conditions which are unsafe for pedestrian traffic or conditions which are unsafe for traffic passing below an overpass. Make appropriate recommendations.

11.0 **RESTORATION OF REMOVED ITEMS:** Contractor shall restore all items temporarily removed and surfaces that were uncovered during the inspection process to a condition matching the surrounding work. All access holes shall be patched.

12.0 **BRIDGE CAPACITY:**

12.1 A structural analysis of the load carrying capacity of vehicular bridges shall be made. Recommended safe load carrying capacity of vehicular bridges shall be based on Department of the Army Technical Manual, TM 5-312, Military Classes (Class W is for wheel vehicle and Class T is for track vehicle). and, AASHTO class. For indeterminate structures, moment distribution or computer program or similar techniques should be used for structural analysis to determine the safe load carrying capacity. Stresses used shall comply with the manual of Maintenance Inspection of Bridge. The recommended load capacity shall be recorded so that signs can be constructed in compliance with the IB-40 Manual on Uniform Traffic Control Devices.

12.2 A structural analysis of the load carrying capacity of railroad bridges shall be made. Recommended safe load carrying capacity of the railroad bridges shall be based on AREA Cooper Loading.

12.3 A structural analysis of the load carrying capacity of pedestrian bridges shall be made. Stresses used shall comply with the Manual for Maintenance Inspection of Bridges. Dead load, live load, ice, snow and wind shall be considered in the analysis of capacity.

13.0 **REPORT:**

13.1 Drawings: The Contractor shall submit sketches or a copy of as-built drawings on 8 1/2 x 11 loose leaf paper with the report; Minimum requirements for sketches are a plan, an elevation and a cross section. Additional sketches necessary for structural analysis shall be included. Sketches shall be of sufficient detail to verify load limit calculations.

13.2 Structural Calculations: If structural calculations were not available, the contractor shall submit calculations verifying the adequacy of bridge structural members to carry design loads. If existing structural calculations are available, the contractor shall review and verify the existing documents to assure the adequacy of bridge structural members to carry the design loads.

13.3 Causes of Deficiencies: Insofar as practical, the Contractor shall indicate in his Inspection Report the causes-of the deficiencies.

13.4 Recommendations: Recommendations concerning repairs may be classified into two general categories: (1) Urgently needed repairs and (2) Programmed repairs; i.e., repairs that will be incorporated into preprogrammed repair and maintenance schedules. The inspector must decide whether a repair is urgent. Whenever emergency repairs are needed, recommendations may call for repairs of a temporary nature and

they must later be integrated into a permanent solution. It shall be recommended that repairs be made on a permanent basis, if such repairs can be completed as quickly and as efficiently as any available temporary means. Contractor should describe fully the type of repairs that are needed, the method of repair to be used, the scope of work to be done, an estimated cost of the materials, labor that will be required to complete the proposed repair of each item. The Contractor shall provide a recommendation as to the allowable structure loading (rating) as indicated in the Inspection Report. [Special military loadings for specific structures as indicated shall be evaluated.]

13.5 Photographs: Submit one set of applicable color photographs with the original report. Xerox copies of color photographs are required with additional copies of the report.

13.6 Final Report: The Final Report of each bridge inspected should include the following items:

A. Bridge Data Sheet - See pages B-9 & B-10, Bridge Inspection Report Forms.

B. Component Rating - See pages B-11, B-12, B-13, & B-14, Bridge Inspection Report Form and the rating system explained below.

(1) "9" - new condition

(2) "8"- good condition - no repair necessary

(3) "7" - minor items in need of repairs by in-house maintenance forces.

(4) "6" - major items in need of repairs by maintenance forces

(5) "5" - major repairs - contract needs to be let

(6) "4" - minimum adequacy to tolerate present traffic -immediate rehabilitation necessary to keep open

(7) "3" - inadequacy to tolerate present heavy load warrants closing bridge to truck or tank vehicle

(8) "2" - inadequacy to tolerate any live load - warrants closing bridge to all traffic

(9) "1" - bridge repairable, if desirable, to reopen to traffic

(10) "0" - bridge, conditions beyond repair - danger of immediate collapse

C. Deficiencies and recommendations -, See page B-15

D. Comments - See page B-15

E. Cost estimate for repair or replace

F. Photos

G. Sketches or drawing for repair

H. Structural analysis or design calculation

13.7 Report Binder: Report shall be submitted in a hardback, loose leaf or three-ring binder.

14.0 **DANGER OF COLLAPSE:**

The Contracting Officer shall be notified immediately, by telephone and in writing, if the condition of the bridge is such that use will be dangerous to persons or property.

BRIDGE INSPECTION REPORT FORM

A. Bridge Data Sheet

Bridge Name:	
Location:	
Date of Inspection:	
(1) Location - Principal Route	
Over Under:	
(2) Design Load:	
(3) Military Load Classification:	
(4) Date Built:	
(5) Traffic Lanes:	
(6) Transverse Section:	
Roadway	
Sidewalk:	
Horizontal C1:	
Vertical C1:	
(7) Structure Length:	
(8) No. of Span:	
(9) Plans Available:	
(10) Inspection Records:	

YEAR INSPECTED	INSPECTOR	QUALIFICATION

BRIDGE INSPECTION REPORT FORM (Cont'd)

(11) Bridge Description:	MATERIAL	REMARKS
a. Superstructures		
Deck		
Floor System		
Curbs		
Railing		
Sidewalk		
Other		
b. Piers		
Foundation (Piers)		
Abutment A		
Abutment B		
Foundation		
Cap		
Post or Column		
Footing		
Pile		
Others		
c. Wearing Surface		

BRIDGE INSPECTION REPORT FORM (Cont'd)
B. Bridge Components Rating

BRIDGE NAME	LOCATION	POSTED LOAD LIMIT	DATE INSPECTED	INSPECTOR

	COMPONENTS CONDITION RATING	REMARKS
TRAFFIC SAFETY FEATURES		
1. Bridge Railing		
2. Transitions		
3. Approach Guiderail		
4. Approach Guiderail Terminal		
Superstructure		
Deck		
1. Wearing Surface		
2. Deck Structural Condition		
3. Curbs		
4. Median		
5. Sidewalks		
6. Parapet		
7. Railing		
8. Drains		
9. Lighting Standards		
10. Utilities		
11. Expansion Joints		

BRIDGE INSPECTION REPORT FORM (Cont'd)

BRIDGE NAME:	COMPONENTS CONDITION RATING	REMARKS
Support Structure		
1. Bearing		
2. Stringers		
3. Girders		
4. Floor beams		
5. Trusses General		
6. Paint		
Superstructure General Rating Condition		
Substructure		
Abutments		
1. Wings		
2. Backwall		
3. Bearing Seats		
4. Breast Wall		
5. Weep Holes		
6. Footing		
7. Piles		
8. Erosion or scour		
9. Settlement		

BRIDGE INSPECTION REPORT FORM (Cont'd)

BRIDGE NAME:	COMPONENTS CONDITION RATING	REMARKS
Piers or Bents		
1. Caps		
2. Bearing Seats		
3. Column, Stem or ?		
4. wall		
5. Footing		
6. Piles		
7. Bracing		
8. Erosion or Scour		
9. Settlement		
Pile Bents		
Caps		
Bearing Seats		
Piles Bracing		
Substructure General Rating Condition		

BRIDGE INSPECTION REPORT FORM (Cont'd)

BRIDGE NAME:	COMPONENTS CONDITION RATING	REMARKS
Channel & Channel Protection		
1. Channel Scour		
2. Embankment Erosion		
3. Drift		
4. Vegetation		
5. Fender System		
6. Spur Dikes & Jetties		
7. Rip Rap		
8. Adequacy of Opening		
Approach Alignment		
1. Alignment		
2. Approach Slab		
3. Relief Joints		
4. Approach		
Guiderail		
Pavement		
Embankment		
General Rating Condition of Bridge		
General Remaining Life of Bridge (Inspector's Appraisal)		

C. DEFICIENCIES AND RECOMMENDATIONS

BRIDGE NAME:			
Bridge Components	**Condition Rating**	**Observed Deficiencies**	**Recommendations and Remarks**

D. Comments:

SECTION 2
INSPECTION OF STEEL BRIDGE COMPONENTS (FOUNDATIONS, SUPERSTRUCTURE AND APPURTENANCES)

2.1 **SCOPE:** The requirements of this section supplement those contained in the general specification for bridge inspection.

2.2 **DETERMINATION OF DEFICIENCIES:**

2.2.1 Inspect Steel Substructure:

2.2.1.1 General: Inspect for rust, collision damage, debris around bases, movement, placing of fill not provided for in original design causing unstable conditions, corrosion especially at joints and spaces, damage from collision or overstress, unusual movements under heavy load, cracking in flanges, webs, and welds, debris around pile bases, rotation of steel caps on pile bents, broken connections and cracked welds or loose rivets or bolts in bracing, inadequacy of web stiffeners, and need for painting.

2.2.2 Inspect Steel Superstructure:

2.2.2.1 General: Inspection shall include, but not be limited to: girders, stringers, floorbeams, diaphragms, cross frames, portals, sway frames, lateral bracing, truss members, bearings, and anchorage. Inspect for corrosion and deterioration along webs and flanges, around bolts and rivet heads, under the deck joints and at any other points which may be exposed to roadway drainage, at any point where two plates are in face-to-face contact at the, fitted end of stiffeners and at collection of debris, especially at the ends of beams. Check for cracks in welds and adjacent metal, (especially at connections and splices or sudden changes in cross section or configuration or other locations subject to stress concentrations or fatigue loadings or improper distribution of load), areas where vibration or contraction or movement could or has produced fatigue stress or overstress, misalignment or distortion, wrinkles, waves, damage to members, and when excessive vibration or deflection occurs under load.

2.2.2.2 Composite Construction: Inspect for deterioration of concrete or steel such that composite action is endangered.

2.2.2.3 Eyebars, Cables and Fittings: Inspect for deficiencies including rust and deterioration, looseness, cracking, collision damage, and misalignment.

2.2.2.4 Bearings Anchor Bolts: Inspect metal bearings for corrosion, misalignment, frozen bearings, loose bearings, collection of debris around rockers, pins, and rollers, and excessive rocker tilt. Inspect elastomeric bearing pads for splitting or tearing, either

vertically or horizontally, bulging, variable thickness other than that which is due to the normal rotation of the bearing, and abnormal flattening. Inspect anchor bolts for looseness, missing nuts, stripped threads, and deterioration of protective coating.

2.2.3 Inspect Steel Appurtenances (including but not limited to the deck, grating, curbs and sidewalks):

2.2.3.1 Corrugated Metal Deck and Grating: Inspect for deterioration resulting in loss of section, loose deck fasteners, rust and corrosion, cracked or broken welds, slipperiness when wet, and pulling away from support.

2.2.3.2 Steel Curbs: Inspect for horizontal and vertical misalignment, collision damage, rust and corrosion, loose connections and anchor bolts, and inadequate curb height due to addition of wearing surface.

2.2.3.3 Steel Sidewalks: Inspect for corrosion and deterioration, loose connections, inadequate sidewalk drainage, structurally unsound sidewalk brackets, and hazardous walking conditions.

SECTION 3
INSPECTION OF TIMBER BRIDGE COMPONENTS (FOUNDATIONS, SUPERSTRUCTURE AND APPURTENANCES)

3.1 **SCOPE:** The requirements of this section supplement those contained in the general specification for bridge inspection.

3.2 **DETERMINATION OF DEFICIENCIES:**

3.2.1 General: Inspection of all timber substructure, superstructure and appurtenances shall include but not be limited to movement or settlement, misalignment, fungus decay, insect damage, deterioration due to a weathering, abrasion damage, splitting or crushing of timber at points of bearing, excessive deflection under load, loose splices and connections, collision damage, deterioration of metal connections, and loose, deteriorated, warped, or missing members.

3.2.2 Inspect Timber Substructure: Inspect timber piles for unplugged holes, vegetation between timbers at joints or in areas of deterioration, additional embankment earth beyond design criteria, and accumulation of debris against piles. A minimum of two borings shall be taken in each pile bent to determine the interior condition of the piles. Holes shall be treated with preservative oil by means of an approved pressure bolt hole treater or with hot preservative oil by other approved methods. Plug holes with treated plugs.

3.2.3 Inspect Timber Superstructures: Inspect timber girders, beams and stringers and for improper functioning of bridging. Inspect timber trusses for fire hazards, and broken, deteriorated or loose split ring shear connectors. Inspect timber decks for loose, broken or worn plank, and slipperiness when wet. Inspect top of deck for an excessive quantity of loose material and for growth of vegetation.

3.2.4 Inspect Timber Appurtenances including curbs and sidewalks: Inspect timber curbs for inadequate curb height due to addition of wearing surface. Inspect timber sidewalks for protruding nails, inadequate sidewalk drainage, unsound materials, and inadequate floor plank support.

SECTION 4
INSPECTION OF CONCRETE BRIDGE COMPONENTS (FOUNDATIONS, SUPERSTRUCTURE AND APPURTENANCES)

4.1. **SCOPE:** The requirements of this section supplement those contained in the general specification for bridge inspection.

4.2 DETERMINATION OF DEFICIENCIES:

4.2.1 General: Inspection of all concrete substructure, superstructure and appurtenances shall include but not be limited to movement or settlement, plugged weep holes at drains, debris or standing water especially at bearing seats, damage due to overstress or collision, corrosion of reinforcing as evidenced by discoloration, misalignments, excessive vibration or deflection under load and cracking, spalling or deterioration in general and especially near bearing, and joints.

4.2.1.1 Special attention shall be given to vertical cracking near tension reinforcing, diagonal cracking near supports, longitudinal cracking of flange surfaces and horizontal cracking at the end of members.

4.2.2 Inspect Concrete Substructure: Inspect concrete piles for loss of section and corrosion of metal pile shell. Inspect footings on piles for loss of section, movement and differential settlement. Inspect spread footings for loss of section, movement and differential settlement and scour. Also, inspect for any addition of embankment earth beyond design criteria.

4.2.3 Inspect Concrete Superstructure: Inspect precast beams and prestressed girders for cracking. and spalling in cast in place diaphragms due to differential creep, humping or cambering of members. Inspect top and bottom of slabs for deficiencies. Inspect wearing surface for scaling, spalling, cracking, deterioration, water leakage, slippery wearing surface, corrosion or exposure of reinforcing steel, and cracking and deterioration of

sealant in cracks and joints other than expansion joints.

4.2.3.1 Composite Construction: Inspect for deterioration of concrete or steel such that composite action is endangered. (Movement between deck slab and support girder or beam top flange.)

4.2.3.2 Bearings for Concrete Beams: Inspect metal bearings for corrosion, misalignment, frozen bearings, loose bearings, and collection of debris. Inspect elastomeric bearing pads for splitting or tearing, either vertically or horizontally, bulging, variable thickness other than that which is due to the normal rotation of the bearing; and abnormal flattening. Inspect anchor bolts for looseness, missing nuts, stripped threads, and deterioration of protective coating.

4.2.4 Inspect Concrete Appurtenances Including Curbs and Sidewalks: Inspect concrete curbs for scaling, spalling, inadequate curb height due to addition of wearing surfaces, and loose or deteriorated joint sealant. Inspect concrete sidewalks for scaling, spalling, inadequate sidewalk drainage, hazardous walking conditions, and loose connections or deteriorated sealants in joints.

SECTION 5
INSPECTION OF MASONRY BRIDGE COMPONENTS (FOUNDATIONS, SUPERSTRUCTURE AND APPURTENANCES)

5.1 **SCOPE:** The requirements of this section supplement those contained in the general specification for bridge inspection.

5.2 DETERMINATION OF DEFICIENCIES:

5.2.1 Inspect All Masonry for movement or settlement, misalignment, weathering, collision damage, frozen or plugged weep holes and drains, spalling or splitting of blocks, mortar cracks, vegetation, loose or missing stone or brick, loose mortar, water seepage through cracks, damage due to collision or overstress, and addition of embankment earth beyond design criteria. Inspect stone curbs for damage and inadequate curb height due to addition of wearing surface.